Development of a Low Cost Screen to Identify Hearing Loss in Young Children and Appropriate Services for Deaf Children in Binga District, Zimbabwe

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ABSTRACT

There is a high prevalence of hearing loss estimated between 8 and 16% in young children in rural areas in Zimbabwe. Deaf children are usually identified late and do not benefit from early interventions. This study was conducted to evaluate a questionnaire screen in identifying permanent hearing loss in excess of 50dBHL of the better ear, compared with the pure-tone audiometric screen, in children aged 36-72 months living in Binga district, Zimbabwe. Subjects were recruited into the study by using two questions which identified 417 at-risk children who were registered as "Failing" children. In addition, 417 children were recruited as controls who were matched by age and sex and were registered as "Following" children (n=834). The "Questionnaire" screen used for this study had two parts; "Part 1" had 8 general questions for every child, while "Part 2" had 3 age specific sections (A, B and C) with a set of 10 questions in each section and took between 20-25 minutes to administer for each child. The screen was administered on 747 (90%) children of the original sample (n=834) by four trained Tonga fluent interviewers, 87 children (10%) having dropped out. An experienced audiologist administered the gold standard pure-tone audiometry screen on the same 747 (90%) children who were "Questionnaire" screened. There were four test sound frequencies used: 0.5k, 1k, 2k and 4k set at a flat cut-off point of 50dBHL generated by a calibrated Kamplex screening audiometer. The pure-tone screen administration required 10 - 15 minutes per child. Pass or fail results were plotted on the audiogram. For reliability testing of both the "Questionnaire" and the pure-tone screens, repeats were administered on 131 and 110 children respectively who were randomly selected from 747 children. Children with marked physical malformation, neurological problems and those for whom Tonga was not their first language were excluded from the study. The results revealed that the "Questionnaire" screen had a sensitivity of 79% and specificity of 96%. It was inter-and intra-user reliable ($r=0.89$) in identifying permanent hearing loss in children aged 36–72 months ($p>0.05$). The "Questionnaire" was easy to use and found to be a low-cost screen that can be appropriately adapted and used in service delivery or research programmes in different cultural settings in developing countries.

DEDICATION

This work is dedicated to deaf children, whose plight calls for an equal opportunity to access limited resources available in their community in Binga, Zimbabwe. The thesis is dedicated to my wife, Nothando and our sons, Negande and Gunuka who missed but supported me tirelessly during the data collection and write-up stages of this thesis. Their understanding is very much appreciated. I also dedicate this piece of work to my mother, Mrs Mwinga Gunuka, who has rarely seen me for many years now. She supports my zeal of travelling in the world of wondering, and is also my spiritual inspiration. I pray in the name of our Lord Jesus Christ to look after her and to fulfil her hopes and dreams. Finally, I dedicate this project to the sponsors; I sincerely acknowledge their financial assistance which gave me an opportunity to experience this rewarding and fulfilling process in research work.

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The support from the Ministry of Education, by attaching their special education co-ordinator, allowing their school heads, primary and pre-school teachers to be trained and used as interviewers in the field and as resource persons during training sessions is greatly acknowledged. Also special thanks go to these people in the Ministry of Education offices at Matabeleland North Province and Binga District: Mrs Tata (Provincial Psychologist) for her support during training of the pre-school teachers and allowing her lower level staff to participate in this study; Mr Sinampande and Mr Dube (District Education Officers) for allowing the school heads and teachers to participate during the training sessions on how to identify deaf children in the community. Their contributions made this study a reality.

The support from the Ministry of Urban and Local Government for allowing this study to proceed in the villages is greatly acknowledged. A special mention goes to Mr Sithole (Binga District Administrator), Mr Ndebele (Deputy District Administrator) and Mr Mudimba (Chief Executive Officer, Binga Rural District Council) for their facilitation for this study to be adopted by council and endorsing it as a legally operative study in Binga, their support in this respect is greatly appreciated. To all 21 councillors in Binga, I give them a big thank you, for the unconditional support they gave this study. My thanks go to many other organisations and people who contributed tremendously to this study; it is very difficult to list all of them individually without fear of offending; by leaving some out. However, I would like to express my sincere gratitude to all of them here. I honestly acknowledge their contributions, which I valued dearly, and would like to give them a big thank you without singling out names. Their contributions have made it possible to proceed with the fieldwork and the completion of this thesis.

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ABBREVIATIONS

ASHA: American Speech-Language-Hearing Association

AAP: American Academy of Paediatrics

ABR: Auditory Brainstem Response

TOAE: Transient Otoacoustic Emission

EOE: Evoked Otoacoustic Emission

HL: Hearing Levels

HTL: Hearing Threshold Level

HVDT: Health Visitor Distraction Tests

HVQ: Health Visitor Questionnaire

PARC: Portable Auditory Response Cradle

SPL: Sound Pressure Level

MOH: Ministry of Health and Child Welfare

MCDWA: Ministry of Community Development and Women's Affairs

BRDC: Binga Rural District Council

CSO: Central Statistics Office

COMBRA: Community Based Rehabilitation Alliance

OME: Otitis media with effusion

dB: decibel

BSA: British Society of Audiology

BATOD: British Association of Teachers of the Deaf

NDCS: National Deaf Children's Society

CI: Confidence Interval

ICH: Institute of Child Health

CICH: Centre for International Child Health

UCL: University College London

UNISE: Uganda National Institute of Special Education

RNID: Royal National Institute for the Deaf

www: world wide web

UK: The United Kingdom

USA: The United States of America

ICIDH: International Classification of Impairment, Disability and Handicap

CBR: Community Based Rehabilitation

WHO: World Health Organisation

ILO: International Labour Organisation

VCW: Village Community Worker

VHW: Village Health Worker

NICU: Neonatal Intensive Care Units

NGO: Non-governmental Organisation

UNDP: United Nations Development Programmes

UNICEF: United Nations Children's Fund

CHAPTER 1

INTRODUCTION

CHAPTER 1

1.0 Introduction

This chapter describes the general information about this study that was carried out in Binga district, Zimbabwe. It is arranged in the following sections:

1. Statement of the problem
2. Project district
3. Purpose of the study
4. Hypothesis.
5. "Questionnaire" screen
6. Arrangement of chapters of this thesis

These sections are presented in such a way that they give the reader a general overview of the materials contained in this thesis. The next section highlights the problems and consequences of hearing loss in children and it justifies the reason this study was undertaken.

1.1 Statement of the problem

Hearing loss is a common problem in children under 6 years of age in Zimbabwe (Jackson, 1991; Jones, 1974). The problem is usually identified late in children in rural areas. A large population of registered children at regular schools, especially in rural areas, show varying degrees of communication difficulties and have been reportedly performing below standard (Mntungwana-Hadebe, 1997; Nyika, 1997; Peresuh and Ndawi, 2000). Binga Hospital (2001) reported an estimate prevalence rate of hearing loss of 8-16% in excess of >30dBHL averaged across all frequencies in children aged 3-6. Although such estimated figures of children with hearing loss might not be reliable, some school and clinic records indicate problems of increased cases of chronic otitis media in school children. Studies carried out in some countries in Africa, Latin America and Asia suggest that about 6-16% of school children have hearing loss which has implications for their educational needs (Holborow, 1985; Bastos et al. 1995; Lichtig, 1995; Clifford, 1986).

It is the necessity of securing communication and language input for infants that makes it essential for mild to severe sensori-neural and or conductive hearing loss to be detected as early in childhood as feasible. The relevance of early detection of hearing loss has been stressed in several studies (Bastos et al. 1995).

In recent years, progress in science and technology has increased the awareness and access to screening and diagnostic tests for hearing loss in children in developed and developing countries including Zimbabwe. In Zimbabwe, such technology only exist at tertiary levels at university teaching hospitals and other private institutions situated in cities and towns such as Harare, Bulawayo, Gweru, Mutare and Masvingo, where only a few rural people can access audiological services. The inaccessibility of the audiological services available in cities is exacerbated by the fact that there is no routine hearing screen to identify hearing impaired children living in rural areas, where 80% of the population suspected with hearing problems live (Peresuh and Ndawi, 2000; UNDP, 1998; CSO, 1992; Jackson, 1991; Jones, 1974).

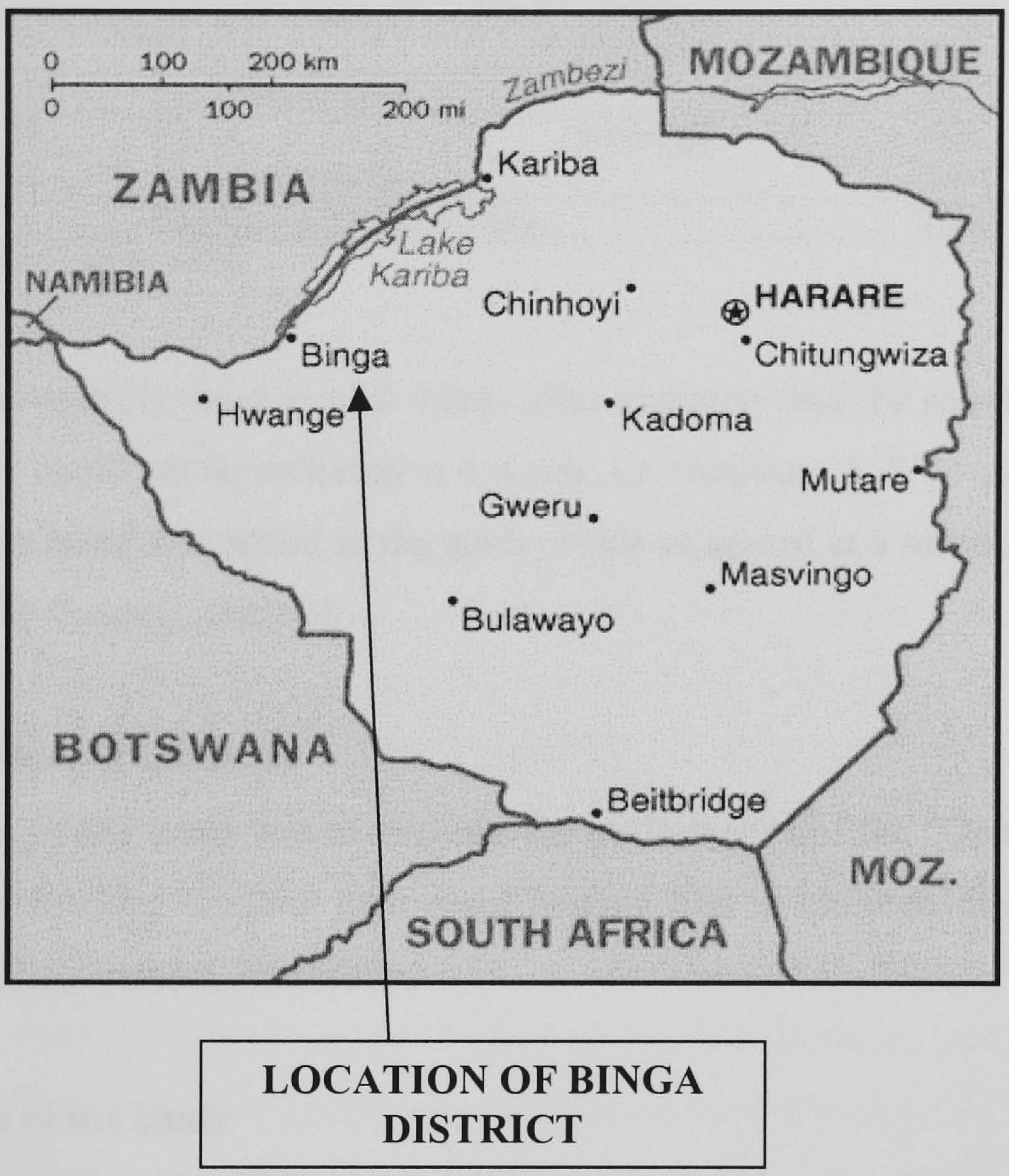
According to a UNDP (1998) report on human resource development in Zimbabwe, the majority of the rural population live in an absolute state of poverty. Binga was ranked the least developed district: with low literacy rate, poor health and communication infrastructure, poor state of road networks, food shortages and unsafe and inadequate water supplies. Therefore, this study selected Binga district as the location of the project, taking into consideration the advice from UNDP offices in Harare.

1.2 Project district

The rural areas of Binga are situated in a dry mountainous region of the Zambezi valley with inadequate and unwholesome water supplies. Binga was chosen as the study location (see Map 1.1) because it was viewed as one of the poorest districts in Zimbabwe (UNDP 1998). There are 3 communal areas and 21 wards making up Binga district council area. The project worked in 5 wards of 2 communal areas.

MAP 1.1: MAP OF ZIMBABWE; LOCATION OF BINGA DISTRICT ALONG THE ZAMBEZI VALLEY

(Geography and Map of Zimbabwe http://geography.about.com/library/cia/blczimbabwe.htm)



The question of sustainability was considered during the inception of the project. It was then decided that village community workers, rehabilitation technicians and teachers were to be used as far as possible in the field so as to impart skills that will enable them to carry on with the project after the end of the pilot study phase (2000-2001) with minimal external assistance.

During this meeting four plus three reserve (*) wards were randomly selected as the project area (see Table 1.1 for details).

Table 1.1: Selected Wards (CSO, 1992)

	Siabuwa Communal Land	Manjolo Communal Land	
Ward Number	Ward Name	Ward Name	Ward Population
1*		Sianzyundu	5386
2*		Simatelele	2185
4		Lubu	2780
5		Muchesu	2181
15*	Sinansengwe		1860
17		Sikalenge	3968
21	Sinampande		3463
Project area total population			21823

*Notes: * denotes reserve wards*

The study eventually worked in 5 wards after realising that the sample required for the study could not be collected in 4 wards, i.e. numbers: 4, 5, 17 and 21.Ward 1, the reserve ward was added to the study wards as agreed at a meeting of Binga Rural District Council (BRDC).

1.3 Purpose of the study

The purpose of the study was to evaluate the performance of the "Questionnaire" screen in identifying bilateral permanent hearing loss in children of ages 36-72 months in Binga district, Zimbabwe.

1.3.1 Aim of the study

This study aimed at identifying bilateral permanent hearing loss in young children in rural areas of Zimbabwe.

1.3.2 Objectives of the study

The study was designed to fulfil the following specific objectives:

- To test the sensitivity and specificity of the "Questionnaire" screen in detecting hearing loss in children compared with the pure-tone screen.
- To test inter and intra-user reliability of the "Questionnaire" screen.
- To assess knowledge, skills, attitudes and practice (KSAP) of head-teachers, pre-school teachers, health workers, village community workers and other community development workers who attended and were trained at workshops conducted by the researcher during the 2000 to 2001 data collection period against their peers who were never involved in this study.

1.4 Hypothesis

This study was attempting to answer the question as to whether or not the "Questionnaire" screen identified deaf children?

It was hypothesised that a reliable questionnaire screen can identify 60-70% of children aged 36-72 months with measured hearing loss in excess of 50dBHL averaged across the frequencies' 0.5k, 1k, 2k and 4k as defined by pure-tone audiometry of the better ear. It was also, hypothesised that non-audiology specialised workers can be trained and reliably use the "Questionnaire" screen in identifying bilateral permanent hearing loss in children in rural Zimbabwe.

1.5 Questionnaire screen

There is enough evidence in the literature (see Chapter 2) pointing to a need to develop and evaluate a simple low cost hearing screen to identify deaf children in developing countries (Hosford et al. 1987; Flipsen, 1995) and this need was also expressed in rural areas of Binga. As well as different kinds of low cost screening tools available, e.g. any of the free field sound makers e.g. Liverpool audiometer, informal toy tests and Manchester rattle, a questionnaire screen could also be used if well prepared, and if the users receive practical training on how to screen hearing loss by carefully following the prescribed interviewing procedures (Sutton and Scanlon, 1999).

This study collected data that was used to evaluate the performance of the "Questionnaire" screen in identifying deaf children in Binga district, Zimbabwe over eighteen months during the first phase. Twelve months later (2002) data were collected to assess knowledge, attitudes and practices of pre-and primary school teachers, community village workers, rehabilitation technicians and other development workers trained during the 18-month (2000-2001) period against those who were never involved in the study. Children who failed the pure-tone screen during the 2000/2001 data collection phase were also followed up in 2002 to ascertain their inclusion at local pre-and primary schools in the five project wards in Binga. These data were collected to assess the impact of the training programme implemented in collaboration with the Ministries of Health and Education in Binga during the initial 2000-2001 fieldwork.

1.6 Arrangement of chapters of this thesis

The chapters in this thesis proceed in a chronological order. Firstly, Chapter 1 sets the scene and introduces the purpose of this study.

Secondly, Chapter 2 reviews the literature on issues of screening hearing loss in young children. This chapter provided underpinning knowledge on the subject which gave the author motivation to proceed with the study in the field.

Thirdly, Chapter 3 describes the methods employed in collecting data for this study. The methods chapter is divided into two parts. "Part A" describes the methods employed in collecting data used to evaluate the performance of the "Questionnaire" screen. "Part B" data was collected to evaluate the performance of the "Two-question" recruitment tool in identifying at-risk children. "Part B" also describes the methods employed, 12 months later, in collecting data that were used to assess KSAP of people who were trained at workshops during the 2000 to 2001 period against their peers who were never involved in the study.

Fourthly, Chapter 4 presents the results of this study which are presented in three parts. "Part A" presents the primary results of evaluating the performance of the "Questionnaire" screen in identifying bilateral permanent hearing loss in young children. "Part B" of Chapter 4 presents the additional results obtained from data collected during the recruitment of subjects; an innovative "Two-question" recruitment tool was used in identifying at-risk children and recruiting subjects of the study. "Part C" results were obtained from analysing data collected 12 months later to assess workshop training programmes implemented as a way of ensuring the provision of appropriate services for deaf children in the study area.

Fifthly, Chapter 5 discusses primary and additional findings of the study in relation to the literature reviewed in Chapter 2 of this thesis. It consolidates the evidence presented in Chapter 4 with arguments raised in the literature review.

Finally, Chapter 6 draws conclusions and makes recommendations for future studies.

CHAPTER 2

Literature review

CHAPTER 2

2.0 Literature review

This is a community health not audiological medicine study and it derives literature from community health, community development, community based-rehabilitation, education as well as some audiological medicine and relevant articles reviewed were sourced from the Institute of Child Health (ICH), the Royal National Institute for the Deaf (RNID), the Human Communication Science, the UCL Libraries and the world wide web by using these keywords; screening, conductive, sensorineural, unilateral, bilateral hearing loss, infants, children. It is based in a country where audiology does not exist (one or two audiologists in Zimbabwe); because of this there is a need to concentrate in other disciplines. The issues critically reviewed are broadly divided into these categories:

- Firstly, the conceptual framework postulated by WHO (2001) i.e. International Classification of Functioning, Disability and Health (ICF) is adopted to analyse the interface of issues of deafness to an individual, the family and the community.
- Secondly, issues concerning hearing loss, including bilateral and unilateral pre- and post-lingual deafness in children, which include aspects of prevalence, consequences, causes and management of conductive and sensorineural hearing loss are reviewed.
- Thirdly, problems of screening hearing loss in children and the appropriateness of key screening protocols as reference tests and for service delivery in rural programmes in developing countries are critical looked into. An appropriate reference test for this study was determined after examining various aspects of suitability, cost and ease of use by less audiology trained workers.
- Fourthly, issues concerning benefits from early identification and early intervention are reviewed.
- Fifthly, factors, which promote community participation in providing audiological services in Zimbabwe, are examined.
- Finally, the implications for hearing screening programmes to identify bilateral permanent hearing loss in children in rural Zimbabwe are examined.

It is believed that unidentified hearing loss in young children retards their language development (Berman 2001). The earlier the identification of bilateral permanent hearing loss (BPHL) in children the earlier the intervention can start and this increases the likelihood of optimising a child's chances to acquire communication skills and cognitive development to create equal opportunities for deaf children in their community (Downs 1995; Bess et al 1998; Hartley and Wirz 2002).

The identification of bilateral permanent hearing loss in children is viewed relevant in developing countries, especially when considering the fact that there are less developed services for deaf children in rural areas (Dube et al 2002; Mumpande 2002; Hartley and Wirz 2002). The effects of temporary and unilateral hearing loss in children are reviewed to emphasise the need to identify bilateral permanent hearing (BPHL) loss in children in developing countries.

This chapter is arranged in 6 sections namely; the conceptual framework, hearing loss in children, screening hearing loss in children, benefits from early identification and early intervention, community participation in audiology service promotion and implications for screening programmes. This point therefore, leads us to the next section, which describes the "conceptual framework" of this study used to analyse issues of disabilities such as deafness in children in a rural community setting in developing countries.

2.1 The conceptual framework of this study

The conceptual framework for disability analysis used by this study is the International Classification of Functioning, Disability and Health (ICF) (WHO 2001), which is a refinement of the WHO's (1980) and WHO's (1998) models of International Classification of Impairments, Activities and Participation (ICIDH-2). ICIDH-2 (WHO 1998) model associates issues of disability with activities and the participation of a person with impairment in her/his community. However, in the ICIDH (1980) model of International Classification of Disability and Handicap it emphasise the removal of barriers which hinder people with impairments to participate in every aspect of their life. The ICIDH (WHO 1980) model of disablement has three interactive elements: impairment, disability and handicap. According to ICDH (WHO 1980) disability is defined as a limitation or lack of ability to perform an activity in a way perceived within a range seen normal (WHO 1980). This model assumes that there is a direct causation linked with disability (such as difficulties in verbal communication) and impairment, such as deafness. WHO (1980) defines impairment as an absence or dysfunction of psychological or physiological of an anatomical structure. ICIDH model further assumes that the interaction between an impairment e.g. deafness and disability such as difficulties in communication is perceived causally associated with the term handicap, which is defined as a disadvantage that restricts the fulfilment of a role considered within a range of normality. These roles depend on age, social and cultural constructs. WHO (1998) in constructing the ICIDH-2 model was responding to the criticism over the term handicap and drew positive experience over the use of the ICIDH (WHO 1980). Bickennbach et al's (1999) proposed some models of Disablement and Universalism based on ICIDH-2 (WHO 1998) consisting of four components which interact with each other between functioning and disability. These are Bickennbach et al's (1999) models of "Disablement and Universalism" components:

- Disablement is a concept based on any restrictions or lack of ability of the body structure and function, personal activities and participation in the community.
- Impairment is defined as the loss or dysfunction of the body structure or physiological function, which limit the activity or participation of the individual in the mainstream community activities.

- Activity is defined as the nature and extent of functioning at the level of an individual.
- Participation is defined as the nature and extent of a person's involvement in mainstream activities in relation to impairments, activity, health conditions and contextual factors.

However, the ICF model differs from the ICIDH, ICDIH-2 and Disablement and Universalism" models due to the fact that the ICF model has two parts each with two components (WHO 1980; WHO 2001; Bickennbach et al's 1999), which are:

Part 1. Functioning and disability

- Body functions and structures
- Activity and participation

Part 2. Contextual factors

- Environmental factors
- Personal factors

The ICF model (WHO 2001) has components, which could be expressed either in positive or negative terms. These components are further sub-divided and classified into various domains. According to WHO (2001) the ICF model has these main domains expressed in health context:

- Body functions: these are physiological and psychological functions of the body, which promote a person's well being and how s/he fits into the society.
- Body structures: these also referring to anatomical parts of the body such as organs, limbs and their components which have a bearing on what activities an individual can do efficiently.
- Impairments: these are problems associated with the body function or the structure and are individual person's limitations in relation to how s/he uses her/his body structures e.g. deafness posses a limitation on an individual in perceiving sound for communication and localisation.

- Activity: this is the execution of a task or action by an individual and is qualified and quantified in relation to age, sex and in context for livelihood or socialisation.
- Participation: this involves the activities a person does in every day life in her/his community.
- Activity limitations: these are problems an individual might have in performing certain activities e.g. some difficulties a profound deaf child using a sign language as her/his first language could have in engaging in an exclusively verbal conversation.
- Participation restriction: this also refers to difficulties an individual such as a deaf child might have in performing every day life activities.
- Environmental factors: these are components which constitute the physical, social and attitudinal environment in which people normally carryout their livelihood survival skills and these components and their interactions are illustrated in Fig 2.1 (WHO 2001).

Fig.2.1: ICF Model of "Functioning" and "Disability": the Interactions between the Components of ICF, adapted from WHO (2001).

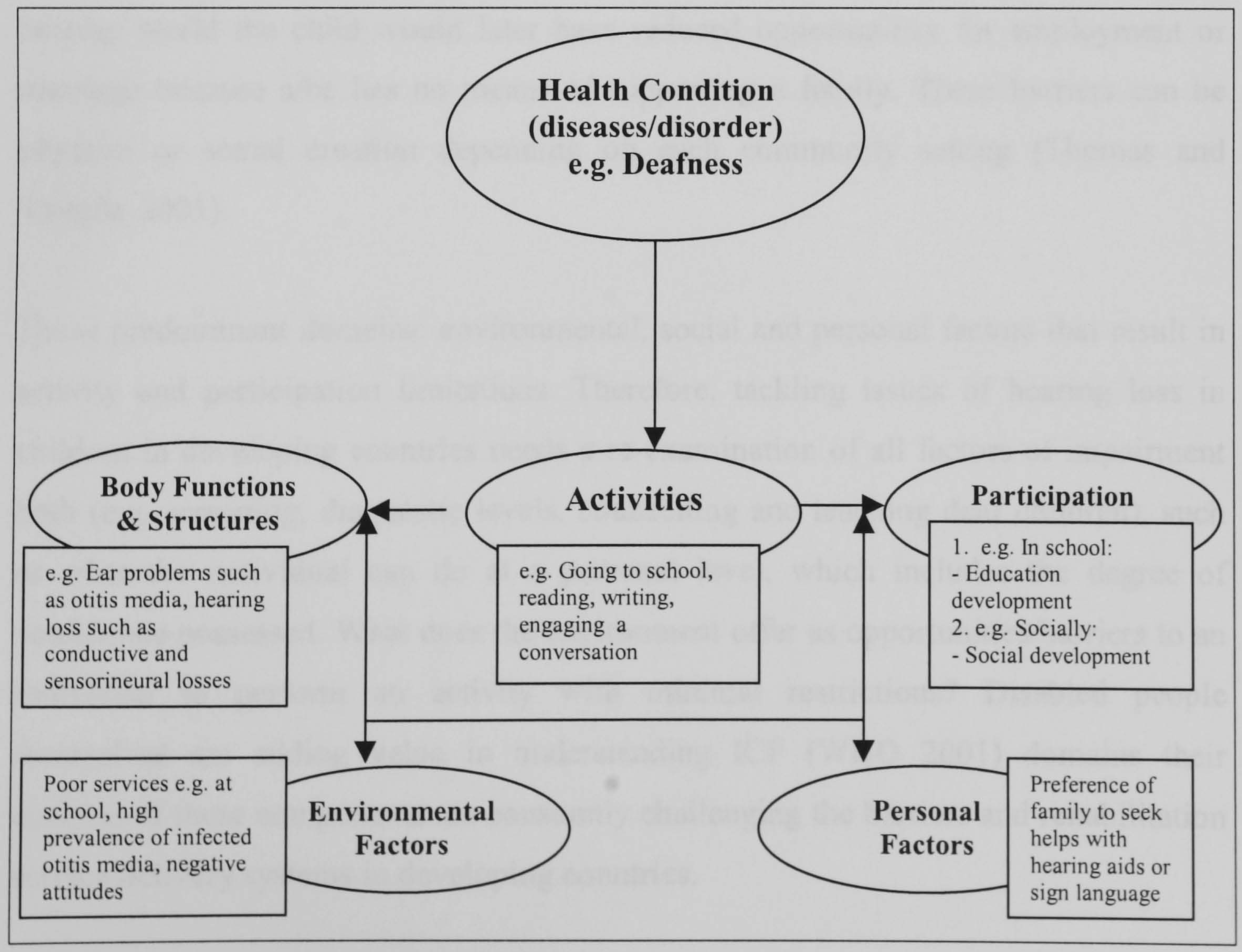


Fig 2.1 illustrates the interactions of the components of ICF model (WHO 2001) of disablement. The hypothesis of this model states that a child with a hearing-impairment has a medical problem of body function and structure, which could be a hearing pathway, affected due to a disease or malformation or absence of the conductive or sensorineural hearing structures. There are several pathological ear diseases or conditions that might affect a child's hearing threshold levels. The degree of the impairment depends on the extent of the physiological and anatomical damages or malfunction of the ear. For example the child could have mild or moderate or severe to profound hearing loss depending on the part of the pathway and the extent of the dysfunction of the affected ear structure. The ear structure as a function of a hearing limitation in relationship to the activity performed depends on factors such as sex, age, culture and traditional norms prescribed by the society (social constructs).

Environmental factors also come into play, if a deaf child can not attend the local school because there are no facilities appropriate for her/his condition (barriers), he can not read, write, develop sufficient communication skills to enable her/him to socialise with her/his hearing peers or family members and community members in general. Because of the verbal limitations and the discrimination imposed by the hearing world the child would later have reduced opportunities for employment or marriage because s/he has no means of supporting a family. These barriers can be physical or social creation depending on each community setting (Thomas and Thomas 2001).

These predominant domains: environmental, social and personal factors that result in activity and participation limitations. Therefore, tackling issues of hearing loss in children in developing countries needs a re-examination of all factors of impairment both (e.g. screening, diagnostic levels, counselling and teaching deaf children), such as what the individual can do at a personal level, which includes the degree of confidence possessed. What does the environment offer as opportunities/barriers to an individual to perform an activity with minimal restrictions? Disabled people themselves are adding value in understanding ICF (WHO 2001) domains their analysis of these components are constantly challenging the barriers and rehabilitation service delivery systems in developing countries.

There is a realisation that professional specific services are so expensive that they are unachievable and non-sustainable, led WHO to promote a low-cost approach called the "Community Based Rehabilitation" (CBR) in the late 1970s. This is a strategy that has been adopted and implemented in many low-income countries (Boyce et al 2001; Thomas and Thomas 2001; Price 2001). The CBR approach attempts to provide rehabilitation services involving the whole community and using local resources and low technology (ILO, UNESCO, WHO, 1994). CBR approach was adopted by this study in attempting to provide valid low cost screen that can be reliably used by non-specific audiological trained community workers to identify hearing loss in children for the purpose of initiating early interventions that can improve the quality of life of deaf children in rural communities (Kandyomunda et al 2002; Schneider et al 2002). This entails a change of attitudes of the community to accept children with disabilities and promote their social integration, provision of equal opportunities and protection of their rights (Thomas and Thomas 2001).

The conceptual framework highlighted and described the important elements of the ICDH-2 (1998) and ICF (2001). This analysis model of disability has provided the underpinning background information of the interface of issues concerning hearing loss in children such as prevalence, consequences of hearing loss in children, causes, management of conductive and sensorineural hearing loss in children these are reviewed in the next section.

2.2 Hearing loss in children

In the ICF, WHO (2001) model deafness is being referred as an impairment due to the dysfunction or absent of the body structure as a result of ear diseases or other conditions e.g. otitis media or sensorineural damage resulting in loss of hearing loss which refers to a limitation to perceive sound. The reference of a normal hearing is a sound just loud enough for a healthy otologically screened young person to hear under physically and psychophysically defined conditions (Harrell 2002; Roeser et al 2001).

The standard scientific and clinical procedure to measure hearing impairment is the sound pressure level (SPL) necessary to hear single-frequency tones at a range of standardised frequencies, i.e. the sound pressure levels at the threshold. These "Hearing Threshold Level" (HTL) values are closely related to the familiar SPL (Harrell 2002; Roeser et al 2001; Northern and Downs 1991). However, the HTL is a quantity in the impairment domain; because it is the minimum audible sound and increasing impairments have increasing positive HTLs (Harrell 2002; Roeser et al 2001). There are many hearing impairment classifications used by several studies only two hearing loss-grading configurations are considered and reviewed. See Table 2.1, which shows the two grading of hearing loss configurations as defined by World Health Organisation (WHO 1991) and was refined by European Union (EU 1996) to meet needs of deaf neonates and infants in European countries where high-technological services are available.

Table 2.1: Classification of hearing impairment (HI) according to WHO (1991) and EU (1996) configuration adapted from Uimonen et al (1999).

Description of HI	Classification	
	WHO (1991)	EU (1996)
Normal	25dBHL	≤20dBHL
Mild	26-40dBHL	20<dBHL<40
Moderate	41-60dBHL	40≤dBHL<70
Severe	61-80dBHL	70≤dBHL<95
Profound	+81dBHL	≥95dBHL

Compiled from the information derived from Uimonen (1999).

Uimonen et al (1999) asserts that the widely used grades of hearing impairment were defined by WHO in 1991 and later the European Union (EU) in 1996 unified the grade and configuration classifications and the terminology used in audiology. In WHO (1991) classification, pure-tone averages (PTA) of the better hearing ear are calculated over the frequencies of 0.5, 1 and 2 kHz, see WHO (1991) and EU (1996) classifications of hearing impairment (HI) in Table 2.1. EU wanted lower thresholds for the definitions of a normal hearing.

2.2.1 Prevalence of hearing loss in children

In order to compare results of community-based studies on prevalence of hearing loss in children, issues pertaining to definitions have to be clear. Roeser et al (2001), White et al (1998) and Uimonen et al (1999) pointed out the terms, which usually cause confusion when comparing prevalence rates from different studies, are:

- Severity (pertaining to the degree of loss of hearing): what are the classifications used? e.g. mild (25-40dBHL), moderate (41-55dBHL) moderately severe (56-70dBHL), severe (71-90dBHL) and profound (>90dBHL) hearing loss (Uimonen et al 1999).
- Type of hearing loss: e.g. conductive (affecting the middle and the external ear) or sensorineural (affecting the cochlea and the auditory nerve) hearing loss. Conductive hearing loss can often be corrected through medical treatments or surgery but the sensorinueral hearing loss is permanent and is not easily corrected.
- Age of onset of the hearing loss: e.g. pre-lingual or post-lingual. Pre-lingual deafness is either the child is born with it or it occurred soon after birth before the child acquires a spoken language.
- Whether it affects one or both ears i.e. unilateral or bilateral.
- Research designs: different research designs produce different results even though research questions are similar.

It is important to describe terms used in a study clearly to compare the prevalence of hearing loss in children from one study to the other. The different prevalence rates are estimated when cut-off-screening levels are being set at different hearing (dBHL) levels. Several community-based epidemiological studies conducted in developed countries reported a prevalence of 1/1000 children with a 50dBHL and 3/1000 with a 30dBHL bilateral permanent congenital hearing loss in children and about 4/1000 children with a 30dBHL when cases of unilateral permanent hearing loss are considered (Zakzouk and Al-Anazy 2002; Berman 2001; Owen et al 2001; White et al 1998; White 1997; Downs 1995), see Table 2.2.

Table 2.2: Summary of the prevalence rates of hearing loss (HL) in children in the USA, the UK and Sub-Saharan African countries.

Type	USA %	UK %	Sub-Saharan Africa %
Bilateral congenital and Pre-lingual (Sensorineural) HL.	0.1-0.3%	0.1-0.3%	0.8-1%
Congenital and ear Diseases in ages: 3-4 4-5 6-9	 12% 18% 3-9%	 2-4% 7-12% 3-4%	 - - (5 – 11%) -
References:	Riko, Hyde and Alberti (1985); Daly (1991); Cross (1985); Northern and Gerkin (1989); White et al (1998); White (1997); Downs (1995)	Bamford and Davis (1998); Bamford and Davis (1998); Haggard (1992); NDCS (1994). Bishop and Edmundson (1986); Gravel and Tocci (1998).	McPherson and Swart (1997); WHO (1998); Jones (1974); Bastos et al (1995); Binga Hospital (2000); Chege (2000); White (1988); Bastos et al (1995).

Compiled from the information derived from various studies conducted in:

- the United State of America (USA)
- the United Kingdom (UK)
- Sub-Saharan African countries which include Zimbabwe

Epidemiological studies carried out in the UK suggest that there are about 0.1-0.3% of children aged 3-9 with bilateral permanent severe to profound hearing loss (Bamford and Davis, 1998; NDCS, 1994). When considering cases of conductive hearing loss (pertaining to middle ear deafness) in school children, the point prevalence of conductive hearing loss as a result of otitis media is about 3% before age 3-4, 12% for age 4-5, and 3-9% for age 6-9 with a 30dBHL in the UK (Bishop and Edmundson 1986; Haggard 1992; Bamford and Davis, 1998). Data from Gravel and Tocci (1998) suggest that bilateral-hearing loss in excess of 30dBHL could be 3-4% in children aged 5-8 in the UK, usually as a result of the conductive hearing loss caused by otitis media with effusion. These estimates from selected articles suggest different trends of prevalence of hearing loss in children. The higher figures for children over 3 years are explained by including cases of otitis media (Naiker 1997; Medley et al 1995; Cole et al 1995).

It is even more difficult to get realistic estimates of prevalence of bilateral permanent hearing loss (BPHL) in Sub-Saharan Africa because of lack of data and methodological limitations of few epidemiological studies carried out within the region show variation. The types of hearing loss in these countries are very difficult to distinguish so the prevalence of hearing loss reported include bilateral permanent (BPHL) and conductive hearing losses due to otitis media. For example, in Southern Africa, McPherson and Swart (1997) reported a prevalence of 3% hearing loss in elementary school children aged 3-7 with a bilateral hearing loss of >30dBHL when cases of conductive hearing loss caused by otitis media are included. While, Swart (1995) and White (1988) estimated 3-7% of bilateral hearing loss of >30dBHL averaged across all frequencies in children aged 2-11 in South Africa and Swaziland respectively. In Kenya, Chege (2000) also reported a prevalence of 6.5% of bilateral hearing loss of >30dBHL at any test frequency in the 500 Hz - 8 kHz range in children aged 3-8.

The few community-and institution-based surveys carried out in Zimbabwe show a wide range of prevalence rates of hearing loss in children. These studies have reported 2-16% of bilateral hearing loss of >30dBHL in children aged 2-11 (Jones, 1974; Binga Hospital Health Information Services, 2001). The earlier study by Jones (1974) estimated 2-8% in school children with bilateral hearing loss of >30dBHL in Zimbabwe. Jones's study also found that bilateral hearing loss of >30dBHL in children in rural areas was 8% compared to 2% of their urban peers. Contrarily, Bastos et al's (1995) study in Tanzania with a sample of 854 school children reported a different outcome than that observed by Jones' (1974) study in Zimbabwe. The prevalence of hearing loss above 30dBHL of 3% in rural areas and a high frequency loss was significantly more among urban than rural children in Tanzania. Prevalence studies reported by various clinical based studies on hearing loss in children in Zimbabwe are also misleading in the sense that there are a number of cases not reported. The non self-referral of cases by mothers or carers could possibly be due to different cultural definitions or the negative views that some tribes in Zimbabwe have towards disabilities. Although a large proportion of hearing-impaired children are not referred to service providers, few institution-based studies estimate prevalence of hearing loss in children (Mahon, Kersner and Nzama, 1996; Nzama, 1996). Despite the fact that numbers of deaf children enrolled in educational institutions in Zimbabwe were reported by several studies these figures are meaningless because they do not give a clear picture of the extent of the problem. For example, Mntungwana-Hadebe (1996) reported 1,373 cases of hearing impaired children in special schools and units in Zimbabwe. However, Nyika (1997) found 1,199 hearing impaired children enrolled in 44 special schools and units in Zimbabwe. Mahon, Kersner and Nzama (1996) and Nzama's (1996) studies found 7,121 children with communication problems receiving services in Zimbabwe. Of this figure, 1,152 were hearing impaired. Binga Hospital estimates 16% of children aged 3-6 with bilateral hearing loss of >30dBHL averaged across four frequencies (0.5k, 1k, 2k and 4k). The apparent difference of prevalence of hearing loss reported is in part explained by whether or not the study included cases of conductive hearing loss due to otitis media.

The various prevalence rates of hearing loss in children reported by different studies could partly be explained by the methodological difference in these studies. Also, lack of robustness in the selection of subjects makes it difficult to get realistic estimates of children with hearing loss in developing countries. Because there are no good data on prevalence of hearing loss in children aged 3-6 in Zimbabwe this could only be guessed. The estimates may range from 5 to 16% of bilateral hearing loss of >30 dB HL in rural areas when cases of otitis media are included (Jones 1974; McPherson et al 1994; Bastos et al 1995; McPherson and Swart 1997).

2.2.2 Consequences of hearing loss in young children

Bilateral permanent hearing loss (BPHL) in children, usually occurs when a child is still very young, mostly before, or at birth, or soon after; this means that it occurs before a child acquires a language. BPHL may retard speech, language, communication and cognitive development in children, especially those with hearing parents. Recent research has shown that there is a higher psychosocial adjustment difficulty of children with hearing impairment attending integrated schools than their hearing peers (Ayodele and Adebomi 2000). Deaf children isolate themselves from the social and emotional demands as a result of their communication difficulties and ineffective interaction approaches (Ayodele and Adebomi 2000).

It appears relevant to underline the view that language and communication skills are a key input in the development of social acceptance (Ayodele and Adebomi 2000; Okwaput 2000). The contentious theory of critical period for speech and language development in children has been appreciated for many years, using observational methods of data collection. In a longitudinal study conducted by Marcotte and Morere (1990), on adolescent Britons with normal hearing and with deafness acquired after 3 years of age suggested left hemispheric dominance for speech production. Marcotte and Morere's (1990) study suggests that the congenitally deaf and those with deafness acquired before 3 years show an atypical, anomalous brain organisation for speech production. This study supports the contentious theory of a critical development period during which environmental deprivation is associated with cortical reorganisation of the normal left hemispheric specialisation for speech regulation (Marcotte and Morere, 1990).

The outcome of Marcotte and Morere's study could not be used to prove the theory of a critical period on language development because their study design lacked robustness for various ethical reasons. It was difficult to control other forms of treatments and rehabilitation intervention for their subjects for ethical reasons. Also, their sample size was very small (39 subjects). The validity of critical period theory in child language development remains uncharted territory and needs empirical evidence and development to learn whether there is a critical period in brain development during which environmental deprivation disrupts normal left cerebral lateralisation for speech (Berman 2001; Haggard 1993; Bishop 1988).

Despite problems associated with the critical theory on language development there are significant problems associated with bilateral permanent hearing loss in children even those with unilateral and fluctuating hearing loss in excess of 30dBHL are behind in all developmental areas (Watkin et al 1995; Fonseca et al 1999; Davis et al 2001). Several studies have demonstrated that children with severe and profound bilateral permanent hearing losses are backwards in reading comprehension compared with their hearing peers. For example, Watkin et al (1995), White et al (1998), Yoshinaga et al (1996) conducted retrospective studies which aimed at looking into the effects of bilateral permanent hearing loss in children. Data, which they collected from these studies, demonstrated that hearing loss in children had detrimental effects on: language, maths and social development. They all concluded that children with unilateral hearing loss were behind their hearing peers in maths, language or social functioning. Despite the fact that the samples of these studies were very small it can be asserted that permanent hearing loss in young children has detrimental effects on educational performance (Watkin et al 1995; White et al 1998; Yoshinaga et al 1996).

There are also inconclusive reports about the effects of fluctuating hearing loss in children on language development (Bishop and Edmundson 1986; Haggard 1992; Berman 2001; Teele et al 2001). The arguments are based on the fact that otitis media with effusion (OME) is self-limiting condition, which resolves itself within 6-8 weeks and as such should not retard language in the long-term. The justification for insistent medical and surgical intervention to OME has been based on the theory that OME and hearing loss can delay the acquisition of language skills, alter behaviour and affect attention patterns.

This assumes that a child is vulnerable to the effects of persistent or fluctuating conductive hearing loss during the first 2 to 3 years of life when the child is experiencing the rapid acquisition of receptive and expressive language skills (Bishop and Edmundson 1986; Berman 2001). Unfortunately, there are few observational cohort studies and randomised intervention trials, which address the question of the effects of OME in language development (Berman 2001). Berman (2001) asserts that there are no studies at the moment, which have conclusive results with significant correlation between OME or hearing loss with any of the measures of attention and behaviour at any age during the first 6 years of life. Notwithstanding lack of strong evidence of OME on language development some research has reported considerable consequences of fluctuating hearing loss in children.

For example, Teele et al (1990) attempted to answer this question by collecting data from Greater Boston. A sample of 194 children was recruited and followed prospectively for 7 years. Data were collected about 7 times per year on intellectual ability, cognitive functioning and language competency and on each visit the episodes of otitis media were recorded during the period from birth to 3 years (Teele et al, 1990). Those children with <30 days of otitis media over the 3-years period were compared with 130 or more days of otitis media over the same period considering the social and economic factors and adjusted statistically, children with fewer episodes of otitis media. Teele et al (1990) then concluded that children with fewer episodes of otitis media performed better than their peers with several episodes on all measured variables and this advantage translates to more than a year's worth of development in reading or maths achievement In spite of the fact that the sample size of this study was small it demonstrated the effects of mild chronic conductive hearing loss in children.

It can be re-emphasised that it is of paramount importance to identify children with bilateral permanent hearing loss, without excluding cases of fluctuating conductive losses, which need to be identified as well, because they are at-risk of language and communication disability (Bishop and Edmundson 1986; Teele et al 1990). There is enough evidence showing that the consequences of mild to severe/profound sensorineural and chronic conductive hearing loss in children have greater effects and if not identified and well managed early retard language and communication development (Bishop and Edmundson 1986;Watkin et al 1995; White et al 1998; Yoshinaga et al 1996).

2.2.3 Causes, severity and types of hearing loss

It is important to consider various issues before planning a treatment and rehabilitation plan for a child with hearing problems. Questions concerning the causes of hearing loss, the severity of this condition and the type of hearing loss whether it is pre- or post-lingual some of these factors are already explained. According to McPherson et al (1994); Swart (1995); Al-Muhaimeed (1996); Lagerkvist (1992), Bastos et al (1995) and Jackson (1991), common causes of conductive and sensorinueral hearing loss in children in developing countries are examined.

Sensorineural and conductive hearing loss in children are caused by several causes such as:

- Genetic disorders, which are, associated with hearing loss e.g. parents carrying dominant genes associated with deafness.
- Prenatal causes, e.g. rubella in pregnant mothers, birth trauma, asphyxia and other problems at or soon after birth.
- Postnatal causes, such as infections, trauma or ototoxins e.g. otitis media and use of some traditional herbs, malaria, meningitis, mumps and ototoxic drugs.

The severity of hearing loss in children relates to the classifications based on different grading configurations such as those defined by WHO (1991) or EU (1996), for example:

- Mild hearing loss ranges from 26-40dBHL
- Moderate hearing loss ranges from 40-70dBHL
- Severe and profound hearing loss is +70dBHL

There are two main categories and descriptions of hearing loss according to the anatomical or physiological dysfunction of the auditory pathway due to diseases or other conditions i.e.:

- Conductive hearing loss; refers to an outer and middle ear dysfunction due to diseases or conditions affecting these auditory pathway structures. The condition can be born with it (congenital) or it occurs after birth (acquired). Congenital cases of conductive hearing loss could be permanent and the acquired cases are usually due to ear diseases such as otitis media and could be cured.

- Sensorinueral hearing loss; refers to the inner ear (cochlea) or auditory nerves dysfunction due to diseases or lesions affecting these auditory pathway structures. The condition can be born with it (congenital) or it occurs at or soon after birth due to various factors already described. The hearing loss can affect both ears (bilateral) one ear (unilateral), usually permanent in nature and is rarely curable. A child could be born with this condition (congenital) or it occurs after birth (acquired). Because congenital cases are deafened before a child acquires a language, this type of hearing loss is also described as pre-lingual. Post-lingual hearing loss is when a child gets affected after s/he has acquired a language.

The majority of mild and moderate of hearing loss are acquired conductive cases due to otitis media in developing countries. There is a high point prevalence of hearing loss in children when cases of conductive hearing loss predominantly due to otitis media and sensorineural hearing loss are considered in a screening procedure. The management of conductive and sensorinueral hearing loss in children is reviewed in the subsequent sub-sections.

2.2.4 Management of conductive hearing loss in children

Despite the fact that the aim of this study is to identify bilateral permanent hearing loss in children mainly caused by the damaged sensorineural auditory structures of the ear, it is a permanent hearing loss, which is due to a dysfunction of the middle and external ear structures. Conductive hearing loss in children due to otitis media and middle ear bacterial infections are serious concerns expressed by parents in developing countries (Chege 2000; Bastos et al 1995).

In some conductive losses due to protracted and untreated bacterial ear infections may progress into bilateral permanent hearing loss in children (Haggard 1992). Conductive hearing loss in the pre-school-age group is most commonly due to increased cases of otitis media with effusion (Augustsson 1990). Medical and surgical treatment of children with otitis media is the first line of intervention. In countries with high technology, auditory thresholds in hearing-impaired children can be improved through amplification with hearing aids and frequency modulation radio devices. Treatment choices like myringotomy and pressure-equalising tube placement can resolve the conductive loss and prevent the re-accumulation of middle ear effusion but this treatment is not feasible in the rural areas in Zimbabwe.

Nevertheless, if hearing loss is detected as part of the routine diagnosis of bilateral permanent hearing loss or management of chronic otitis media with effusion (OME), the management of either sensorineural or conductive loss by standard regimens could be beneficial (Bishop and Edmundson 1986; Haggard 1993). Studies have been unable to provide consistent evidence that clinical interventions for chronic OME (for example, antibiotics, Myringotomy, tympanostomy tubes) are able to achieve sufficient long-term improvement in hearing and language skills to justify the risk of complications (Haggard 1993). A small portion of children routinely screened for hearing loss will demonstrate a protracted hearing-impairment due to previously undetected, less severe, sensorineural loss as well as chronic and recurrent middle ear diseases. These children may be at risk of educational and language problems.

Regardless of arguments concerned with the treatment regimes of otitis media and rehabilitation of fluctuating hearing loss in children, for example Berman (2001) reported improved language development and communication following fitting of hearing aids in children with permanent conductive hearing loss. It is the need to rehabilitate hearing-impaired children to improve their communication skills and their academic performance that creates a pre-requisite to identify bilateral conductive and permanent hearing loss in children through universal screening programmes in developed countries (Fonseca et al 1999; Waltzman et al 2002). Yet, in developing countries it is not cost effective to establish a universal hearing screening to identify children with otitis media in a country such as Zimbabwe due to lack of resources to support such programmes, where poverty and generally poor health conditions prevail in rural areas (Dube at el 2002).

2.2.5 Management of sensorineural hearing loss in children

There are several treatments and rehabilitation regimes, which are instituted when sensorinueral hearing loss in children is, identified such as:

- fitting of hearing aids,
- surgical treatment of providing cochlear implants and
- language stimulation.

In high-income countries cochlear implantation has been highly recommended because there have been several studies recently, which reported the effectiveness of this treatment regime on language development, but all these studies were mainly clinical observations with small samples (Allum et al 2000; Arcbold et al 2000; Garnham et al 2000; Waltzman et al 2002). For example Waltzman et al (2002) conducted a clinical trial observational study to evaluate of multichannel cochlear implants of 81 out 133 deaf children who received these since 1987 and were followed for 5 and 13 years.

Waltzman et al's (2002) study reported significant gains in speech perception, use of oral language and ability to function in a mainstream environment and then concluded that multichannel cochlear implants in children provided perception, linguistic and education advantage, which were not adversely affected by long-term stimulation. The results of this long-term study are convincing because there are from a prospective longitudinal randomly selected case cohorts with well-controlled variables. However, these results are not conclusive because there are few similar studies for comparison at the moment and more so Waltzman et al's (2002) study had a small sample (n=81) for a generalised interpretation of the results.

Other non-randomised, prospective studies have also claimed superior communication performance in pre-lingual deafened children who received and using traditional tactile or acoustic hearing aids as compared to similar children not receiving any form of amplification. Similar arguments are applied to these studies that they lack adequate samples to demonstrate the effectiveness of these interventions (Berman 2001; Geers and Moog, 1991). Instead, in developing countries, auditory, language and communication training can be adapted and improve communication skills (Hartely and Wirz 2002).

The interventions provided for children identified with either conductive or permanent hearing are various. Some of these interventions could be adapted and appropriately implemented in developing countries. The question whether it is relevant to screen hearing loss in children leads us to issues, which are reviewed in the next section.

2.3 Screening hearing loss in children

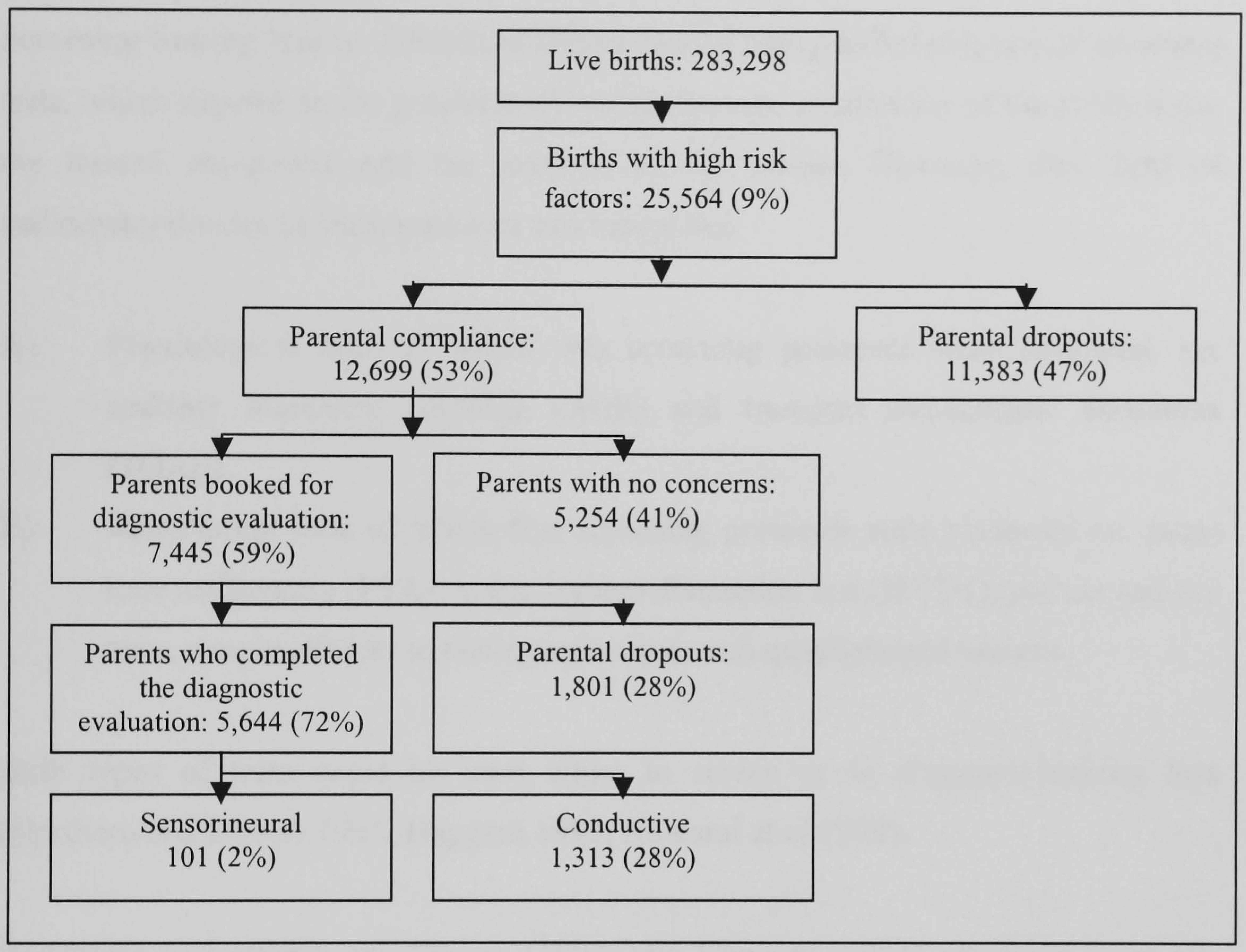
There is adequate data suggesting that the prevalence of permanent hearing loss in high-risk children could be as high as 40% of this high-risk cohort (Al-Muhaimeed 1996) and about 10% of all children born will exhibit one or more of these indicators associated with hearing loss such as a history of congenital hearing loss, very low birth weight (<1500g), congenital perinatal infection, congenital malformations of the head and neck, bacterial meningitis, severe neonatal asphyxia and hyperbilirubinaemia (White 1998; Kawarai et al 1999; Al-Muhaimeed 1996).

Because of these reasons it has been a norm in developed countries to identify hearing loss in young children based on the high-risk indicators in the 1970s to early 1980s. The rationale for the high-risk register (HRR) approach was based on the fact that by focusing on a cohort of the population, which was at-high-risk, medical professionals would be able to use of auditory brainstem response in hospitals. Although such high-risk based screening programmes were the most frequent method used to identify hearing loss in very young children until late 1970s and early 1980s, an effective high-risk-based screening protocol would only identify 43-54% of all children with permanent congenital hearing loss in hospital based HRR in developed countries (White 1998; Kawarai et al 1999; Al-Muhaimeed 1996).

Another problem associated with the high-risk based screening programmes is the high dropout of parents. Mauk et al's (1991) study reported high rates of drop out of parents for diagnostic evaluations because it is difficult to motivate parents to return for the necessary diagnostic evaluations. For example, in Mahony and Eichwald's (1987) and Mauk et al's (1991) studies, which mailed and followed-up the selected parents and free diagnostic assessments were available at regional centres. Mobile vans also went to parents' homes. Despite this effort only half of the parents whose children were at risk attended an appointment and completed a diagnostic evaluation. There are many challenges affecting community-based as compared to institution based programmes especially when parents are not well informed of the benefits of completing the diagnostic procedures of screening programmes.

Fig. 2.1 adapted from Mahoney and Eichwald (1987) and White (1997) shows an example of screening programme evaluated to determine the compliance of parents with identified as at-risk who were registered on a high risk register (HRR) screening programme in USA by Mahoney and Eichwald (1987).

Fig. 2:2 shows the problems of parental dropouts on the at-risk surveillance programme using birth certificates, based on high-risk registry to identify deaf children in Utah from 1978 to 1984 adapted from Mahoney and Eichwald (1987) and White (1997)



Adapted from:

- Mahoney and Eichwald 1987 (pp. 160).
- White (1997): (www.infanthearing.org).

Mahoney and Eichwald's (1987) study, therefore concluded that only 22% of the "at-risk" infants completed diagnostic evaluations hence 101 out of 283,298 (0.36/1000) children were identified with sensorineural hearing loss. Despite the fact that physiological screens are used children identified, as at high-risk is comparably smaller numbers than those screened in universal programmes. The tests usually used to screen the registered high-risk children are the ABR or Transient Otoacustic emissions because they are the most reliably used protocols in evaluating audiological conditions in early infancy and would identify about 50% of infants in efficient community programmes because of problems of parental breaking the appointments for diagnostic evaluation and about 75-80% of hearing-impaired neonates in the intensive care (Mahoney and Eichwald's 1987; White et 1998; White 1997; Kawarai et al 1999).

2.3.1 Screening protocols

Screening hearing loss in children is undertaken by using different types of screening tests, which depend on the precision of measurements, availability of the technology, the trained manpower and the purpose of the screen. However, this field of audiometry divides hearing tests into two categories:

A) Physiological tests of which two screening protocols were reviewed, i.e. auditory brainstem response (ABR) and transient oto-acoustic emissions (TOAE).

B) Behavioural tests of which five screening protocols were reviewed i.e. pure-tone audiometry (PTA), home visitors distraction test (HVDT), picture and toy tests, simple clinical screening techniques and questionnaire screens.

Both types of tests could be used either to screen or to diagnose hearing loss (Northern and Downs 1991; Haggard 1993; Kawarai et al 1999).

According to Northern and Downs (1991) and Haggard (1993) screening is an all-encompassing term, which could be defined as the preliminary acquisition of information for the early detection of a condition. More specifically, a hearing screen is a rapid and simple test and procedure, applied to a generally large population to identify individuals with a high chance of having a hearing-impairment (Haggard, 1993). The concept of identifying a hearing-impairment before it is clinically apparent is an appealing public health consideration. Screening allows large numbers of persons to be evaluated for a hearing problem with less commitment of time, cost and inconvenience than with specific diagnostic tests (Hayes and Northern, 1996). For example, screening hearing loss in children is a fast procedure where a criterion of pass or fail is set, while diagnosis aims to determine the levels, types and possibly establish the aetiology of the hearing loss (Downs 1995). Two important considerations are understood in the above definitions:

- Screening hearing loss in children reveals a likelihood of chance of hearing impairment rather than the certainty of accuracy of this condition.
- Therefore it is not an issue of diagnosis and does not specify the type of deafness or severity of deafness.

It only separates individuals with high and low probability for a hearing-impairment. Persons identified with a positive outcome during the hearing screening procedure must be considered only 'at-risk' of the hearing loss until careful diagnostic testing can accurately determine the presence or absence of this impairment (Hayes and Northern, 1996).

A). Physiological hearing screens

The screening tests that can be applied on infants within their first few days after birth include the Auditory Brainstem Response (ABR), and Transient Evoked Otoacoustic Emissions (TEOAE). ABR is the most reliable frequently used protocol in screening hearing loss in neonates. It has been argued that developmental changes in the central nervous system may affect the results of ABR. Despite these problems several studies demonstrated that the sensitivity and specificity of ABR are estimated at 100% and 97% respectively and the predictive value of positive result could be 95% (Kawarai et al 1999). There is a very low rate of false negative cases. In the USA and the UK, these tests are used in universal screening or high-risk surveillance programmes but rarely used in developing countries because of cost and training involved in setting up these screening programmes.

i). Auditory Brainstem Response

There is information providing enough evidence of the accuracy of Auditory Brainstem Response (ABR) as one of the most efficient screening techniques. In the 1990s ABR has rapidly developed and field-tested to show the performance of this screen in identifying hearing loss in infants (Don and Kwong 2002; Kawarai et al 1999). For example, Hyde et al (1990) conducted a retrospective study to evaluate the performance of ABR in identifying permanent hearing loss >30dBHL. 1367 high-risk babies and were recruited and screened by using auditory brainstem response (ABR) prior to hospital discharge. They were re-assessed at four years old when they were developmentally ready for a pure-tone screening and the results were compared to confirm the results of the initial ABR hearing-screening tests (n=1367). The results showed that the sensitivity and specificity were 98% (44/45) and 96% (1265/1322) respectively, when the ABR screening threshold was set at 30dBHL and 100% (45/45) and 91% (1197/1322) when the ABR screening threshold level was set at 40dBHL (Hyde et al 1990).

The physiological advancement in audiology has seen the revolutionising of the ABR tests in developed countries. There is recent data pointing to the high sensitivity and specificity of the improved ABR tests in identifying hearing loss in infants. This fact can be demonstrated by examining Barsky-Firksner and Sun's (1997) study, which was undertaken in the USA to evaluate the use of Nicolet Compass ABR in identifying hearing loss in infants. 15,749 (97%) out of 16,229 infants born from 1/1/93 to 31/12/95 were recruited and screened at 35dBHL in an intensive care unit and high-risk babies were screened at 40dBHL and 70dBHL without sedation. All the "at-risk" infants were re-evaluated at 6 months later.

Barsky-Firkser and Sun's (1997) study reported that about 52 (3.3/1000) infants were identified with a congenital hearing loss and referred into intervention programmes. This study reported similar prevalence of bilateral permanent hearing loss in children at between 3.1 and 3.3% and this showed that the Nicolet Compass ABR had similar high sensitivity (98%) and specificity (96%) in identifying hearing loss in children (Hyde et al 1990; White et al 1998). The other point is the fact that Barsky-Firkser's (1997) study had a considerable large sample size, which indicates that the results of physiological tests reported could be accurate in identifying deaf children.

But this technology does not exist in rural Zimbabwe so the ABR protocol cannot be a choice test either for service delivery or research purposes in Binga District because the technology required is unsustainable in rural Zimbabwe. The cost per child identified with hearing loss is very high. Also, the level of technicians required operating the equipment and protecting it from being affected by the climate or damage from transportation is beyond the means of many countries in developing countries.

ii). Transient Otoacoustic Emissions (TEOAE)

There is also information providing enough evidence of the accuracy of Transient Otoacoustic Emissions (TEOAE) as one of the most non-invasive and efficient screening techniques widely used in developed countries. The last decade has rapidly developed, validated and perfected the performance of TEOAE screen in identifying bilateral permanent hearing loss BPHL) in infants (Prieve and Fitzgerald 2002; Don and Kwong 2002; Kawarai et al 1999). TEOAE is also one of the frequently used protocols to evaluate audiological conditions in young children in universal or HRR programmes in developed countries (Prieve and Fitzgerald 2002). Several studies have reported that the sensitivity and specificity of TEOAE ranges from 98-100% and 96-98% respectively (Plinkert et al 1990; White et al 1994; White 1997; Prieve and Fitzgerald 2002; Don and Kwong 2002; Kawarai et al 1999). These screening protocols have a predictive value for positive ranging from 88-92% and show that these physiological tests are valid screening procedures and have a potential use in universal screening programmes in developed countries.

As already said, the performance of TEOAE protocols are very high, many studies had confirmed these high performances of the TEOAEs in identifying sensorineural hearing loss in young children (Prieve and Fitzgerald 2002). For example, Plinkert et al's (1990) study recruited 95 ears of high-risk new-borns children who were screened by used of the TEOAE and compared with the Auditory Brainstem Response (ABR) screen set at cut-off point of ≥30dBHL. Plinkert et al (1990) reported that the sensitivity and specificity of TEOAE were 98% and 96% respectively and concluded that TEOAE was a potential alternative procedure to ABR in identifying permanent hearing loss in young children. Kennedy (1991) also evaluated the TEOAE-based new-born hearing screening, where 223 at-risk infants were recruited from the neonatal intensive care units and screened by use the TEOAE whose results were compared with the ABR screen set at ≥35dBHL. The TEOAE and the ABR identified the same 3 infants with sensorineural hearing loss as the AABR, which were, confirmed so by the PTA later when these children were older (1,733 of 1,850 infants were screened by use of TEOAE and were compared with ABR and PTA later). This study then concluded that the TEOAE had a sensitivity of 100%. White et al (1994) also reported that the sensitivity of TEOAE compared with ABR was 100% (11/11) and the specificity was 95% (1643/1722). White et al's (1994) study results are particularly convincing because the data collected were from one of the large-scale evaluations of otoacoustic emissions in a universal newborn hearing-screening programme, which was led by Vohr between 1990 and 1994 at Rhode Island. See Table 2.3).

Table 2.3: Accuracy of TEOAE 2-stage Rhode Island Hearing Assessment Programme (RIHAP) screens in identifying children with sensorineural hearing loss adapted from White et al's (1994)

RIHAP Screen	Hearing status		
	Fail	Pass	Total
Fail	11	79	90
Pass	0	1643	1643
Total	11	1722	1733

Adapted from:
- White et al (1994), (pp. 214).
- White (1997): (www.infanthearing.org).

Data from these studies, which evaluated the performance of TEOA, and ABR protocols provided more definitive information that these two physiological tests reviewed have a high true sensitivity and specificity ranging from 98-100% and 95-98% respectively. Whether the ABR or the TEOAE is used, the equipment is becoming faster and more accurate with each passing year. The 1990s have seen dramatic changes in both physiological and behavioural techniques and it is safe to predict that similar advances will occur during the next decade. There are high innovative techniques coming into the field of audiologic medicine and the use of the ABR and the TEOAE are as such being used in Primary Health Care delivery systems in developed countries (White et al 1998). Also, the TEOAE's are less invasive than ABR. The latter requires the playing of several electrodes while the former is just a probe in the ear for a few seconds much more user friendly especially with young children (Plinkert et al 1990; Kennedy et al 1991; Prieve and Fitzgerald 2002).

B). Behavioural hearing screens

Behavioural assessments of children when they are 7-9 months old are still being used extensively in developed countries. In Europe, audiologists screen first and followed by testing pure-tone hearings threshold in children at health centres and hospitals while home visitors who are already making routine visits as a part of the well-child health care system do the screening by using the distraction test (Haggard 1993). In contrast in the USA, it is usually the doctors who screen children as part of the well-baby care system (Roeser et al 2001). When the babies are 3-9 months of age, there are ready to be tested by using the distraction test and at age 3-6 years these children are developmentally ready for the pure-tone audiometric assessment (PTA) (Roeser et al 2001).

The PTA is reviewed because it has been considered for selection and to be used as the gold standard of this study because this technology exists in urban Zimbabwe. The PTA protocol can be a choice test either for service delivery or research but the technology required is unsustainable in rural Zimbabwe. Nevertheless, the cost per child identified with hearing loss is comparable lower to TOAE's and ABR. Zimbabwe have also, few audiologists and technicians required to calibrate and operating the audiometers and protecting it from being affected by the climate or damage from transportation.

i). Pure-tone audiometry assessments (PTA)

Co-operating children aged between 3 and 6 can be tested more formally because at this developmental stage they are ready for pure-tone audiometry i.e. requires the capacity to respond to sound with reliable repeatable responses (Haggard 1993; Dale 2000; Roeser et al 2001). The pure-tone thresholds audiometric test in sound treated booths has a reported sensitivity of 92% and a specificity of 94% in detecting sensorineural hearing impairment (Roeser et al 2001). PTA results are subject to error due to improper technique, background noise in the test area, and unintentional or intentional misreporting by the subject (Brooks, 1986). Efforts have been made to devise a sufficiently accurate test utilising the pure-tone audiometer (free-field) that is briefer and less costly than standard pure-tone audiometry, but clinical efficacy is not yet sufficiently confirmed (Roeser et al 2001).

The arguments supporting a pure-tone audiometric (PTA) assessments are presented in the results of White et al's (1998) prospective multi-centred study conducted over five years in Washington, which evaluated the effectiveness of the PTA compared to three physiological tests: the ABR, the transient evoked otoacoustic emissions (TEOAE), and the distortion product otoacoustic emissions (DPOAE). The ABR, TEOAE and DPOAE were used to screen: 4,500 NICU babies and 2,600 normal-care nursery babies (over 7000 infants) prior to hospital discharge. Infant Distraction Test (IDT) was done at 8-12 months and a full pure-tone audiometric assessment (PTA) of these children was conducted at 5 years of age. The PTA was completed in October 1997 and the final results from the study were available by April 1998 (White et al 1998).

White et al's (1998) provided definitive information about the sensitivity (92%) and specificity (94%) of a full pure-tone audiometric assessment (PTA), which were reported by several studies (White et al, 1998; Sutton and Scanlon, 1999). The few audiologists screening hearing loss in children in Zimbabwe use the PTA because they find it easy to use, is also readily available in big cities, can operate on batteries or mains, it is portable for rural environment and has a high sensitivity and specificity in identifying deaf children. An alternative reference test that could have been selected by this study is a home visitor distraction test (HVDT) and it is also reviewed.

ii). Home Visitor Distraction Test (HVDT)

The Home Visitor Distraction Test (HVDT) is often advocated as an alternative screening protocol in developed countries, the data on the success of the HVDT is disappointing (Sutton and Scanlon, 1999). For example, Watkin et al's (1990) retrospective study analysed over 55,000 children in one geographical district in England. For each of the 171 two to fifteen year old children who had a hearing loss, Watkin et al (1990) determined whether the child was first identified through a home visitor or school-age screening programme, a parent or someone else, such as a doctor or teacher.

Watkin et al's (1990) study reported the sensitivity of the home visitor and school screening programmes of 58%. The fact that the screen used by these programmes was the HVDT this shows that it had a low sensitivity in identifying nine-month age group. Both the nine-month and the school-age screening programme missed more than a third of the children. Of the 39 children with severe/profound bilateral hearing losses, only 44% were identified from the Home Visitor Distraction Test of the children with mild or moderate bilateral loss and those with unilateral loss, only 25% and less than 10% respectively, were identified by the Home Visitor Distraction Test. So, even with home visitors who were specifically trained to do that type of behavioural assessment and they were given a great deal of support and monitoring to do it well, but most of the children with hearing loss were being missed (Watkin et al 1990).

Another controlled trial was conducted to compare the HVDT with other screening methods (Hunter et al., 1994). According to Hunter et al (1994), the trial in Wessex compared 21,000 babies given TEOAE screening (ABR was used for those failing the test) with 29,000 babies who received only the HVDT at 6-8 months. These results suggest that the cumulative yield in the HVDT-only group is lower at 0.7 per 1,000 by 18 months old, suggesting that false negatives will emerge later. Only 0.1 hearing problems per 1,000 births were actually detected by the HVDT since most were identified due to parental or professional concern or passed the HVDT incorrectly (Hunter et al 1994).

The distraction test carried out by health visitors (HVDT), or by a health visitor and a trained assistant (Haggard 1993), is more widely used in the UK. It is administered at about 6-9 months of age and assesses the infant's ability to turn and locate a sound source. Before the introduction of ABR and TEOAE in universal screening programmes the HVDT was once used as a universal hearing screen in about 98% of health districts in the UK and achieved coverage of 90% of all infants (York University (1997). Sutton and Scanlon's (1999) study reported that the HVDT is not effective when measured against the criteria stipulated by the Deaf Children's Society; i.e. deaf children to be identified at less than one year of age. Its sensitivity is around 42%, and it is not a good tool to use since at about £25 per child, it is costly to implement the protocol (Sutton and Scanlon 1999) compared with £21 per child when TOAE or ABR is used (Stevens et al 1997). There is also variability in the way the HVDT is carried out, e.g. the sound generators used, the number and level of training of the people doing the testing, and the testing of the soundproofing of the room. This leads to concerns about the number of children with problems that are not identified during the screen under present arrangements (Sutton and Scanlon 1999; Fonseca et al 1999).

The published evidence on test performance from clinic based retrospective studies and case note-reviews indicate poor and variable sensitivity (detection rate) and specificity (true negative rate) for the HVDT. The cumulative yield is low, being about 50% by 18 months of age. The average age of confirmation of hearing impairment via the HVDT is from 12-20 months, with subsequent age of hearing-aid fitting following the HVDT being about 18 months (York University 1997). Regardless of the low sensitivity of the HVDT reported by Sutton and Scanlon (1999) for those aged below 18 months, it has demonstrated high sensitivity and specificity of 80% at the age above 30 months.

Sutton and Scanlon's (1999) controlled trial was conducted to compare the HVDT and the questionnaire adapted from McCormick's (1988) screen in England (Sutton and Scanlon 1999). According to Sutton and Scanlon (1999), the trial in Berkshire compared 51,000 babies given the "Questionnaire" screen and the HVDT (ABR was used for those failing the test). The questionnaire failed 33,000 babies and the HVDT failed 33,400 babies at 6-8 months of age. These results suggest that the "Questionnaire" screen and the HVDT compared with the ABR test for screening infants of 6-8 months of age have a sensitivity of 39% and 42% respectively. At ages 4 and 5, the "Questionnaire" screen was compared with the HVDT and was reported to be sensitive and specific (87% and 89% respectively) compared with pure-tone audiometry results (Sutton and Scanlon 1999; Fonseca et al 1999). HVDT is reliable test for children aged 3-6 years, which is the target group of this study. But it is very difficult to implement in rural areas by less audiology trained workers. For this reason the HVDT was not recommended as a gold standard (reference test) for this study.

iii). Low-cost behavioural hearing tests

There is available literature supporting the performance of simple behavioural tests that could easily be adapted for use in developing countries. There are simple behavioural tests that are performed by clinicians or general practitioners, such as a picture or toy tests (Bellman et al 1996; McCormick 1993), whispered voice test (Eekhof et al 1996) and questionnaire screens (McCormick 1988; Dube 1995; Wirz et al 2001), which are simple clinical techniques, used to assess hearing. For instance in developing countries, Bellman et al's (1996) study suggests that the use of toy and picture tests or a questionnaire screen in a face-to-face interview situation might be more appropriate low-cost behavioural hearing tests reviewed are categorised as follows; iv) picture and toy tests, v) simple clinical screening techniques and vi) questionnaire screens.

iv). Picture and Toy Tests

In the UK, a toy or picture test is used to test children over the age of 18 months, when performance testing is difficult to implement. In current use are, one-picture and three-toy tests, listed below.

Picture test:

- The Stycar 5 Picture Test (Sheridan 1968)

Toy tests:

- The Kendall Toy Test (Kendall 1957)
- The McCormick Toy Test (McCormick 1993)
- English as Second Language (ESL) Toy Test (Bellman et al 1996)

The Stycar 5 Picture Test (Sheridan 1968) has been widely used for many years now and has been reportedly performing highly compared with the standard tests. The Stycar Picture concept has been adapted to form the recently used Toy Tests in the UK (Harries and Williamson 2000; Bellman et al's 1996; McCormick 1993). For example Harries and Williamson (2000) reported a high sensitivity (100%) and specificity (94%) of McCormick Toy Test (1993) compared with standard tests for screening children (n=65) aged 36 months in a community setting. This test was reported with a predictive value of 82% (Harries and Williamson 2000).

Bellman et al's (1996) study evaluated a new English word list (English as a Second Language) and toys adapted from the McCormick Toy Test (1993) to screen hearing loss in children of Indian language groups, particularly the Bengali and Sylheti. The ESL Toy Test was evaluated in East London, Borough of Tower Hamlet. They recruited 56 children of Bengali and Sylheti language cohort and administered the ESL Toy Test. Bellman et al's (1996) study reported that at least 50% of the test words were identified at 40dB SPL (25-30dB HL) compared with the pure-tone audiometry (PTA). The ESL Toy Test was reported with a high predictive value in identifying hearing loss in children aged 3-6, with 87% and 90% sensitivity and specificity respectively (Bellman et al's 1996). The Bellman et al (1996) ESL Toy Test could be used for screening or as diagnostic procedures.

In spite of the fact that these studies had small samples the Toy and Picture tests are indicative that they could be used to screen hearing loss in older children (+3 year-olds) in the community. The concept of adaptability could be borrowed from Bellman et al's (1996) study based on a vocabulary list of common words more widely used by non-native English-speaking children in London, some of these toy tests could be adapted and used in developing countries.

However, these tests were inappropriate and not adopted for this study because the words/toys selected for the tests are phonetically balanced and carefully controlled with other words/toys, which could be easily lost in the translation. Also, these tests require an understanding of familiar English words in a cultural context, which could not be wholesomely transferable from one country to another. With careful adaptation the concept of the toy test could be applicable in most situations in developing countries. As said before the toys and words used cannot be appropriately used (without modification) for rural children in Zimbabwe.

v). Simple screening techniques

There are a few other simple behavioural tests that are performed by clinicians, such as the whispered voice test (Eekhof et al 1996) which is a simple clinical technique used to assess hearing in young children. Reported sensitivity and specificity have been 70-100% using the pure-tone audiometry as the reference standard set at 40-50dBHL cut-off point. There are inadequate data on inter-observer variability of a whisper test (Mulrow and Lichtenstein 1991). The free-field voice, tuning fork, and finger rub tests have been criticised on similar grounds of variability (Mulrow and Lichtenstein, 1991). If the rate of hearing impairment is high in older children aged 7-10, Sever et al (1989) recommend written patient questionnaires, clinical history taking and physical examination, audiometry with a hand-held device, and simple clinical techniques designed to assess for the presence of hearing impairment. However, these screening tests are not widely used and have not been fully evaluated in developing countries. Considering the ease and the reliability of the reviewed screens this project therefore chose PTA as the gold standard (reference testing). The other tests the ABR and TOAE require expensive technically complicated equipment that requires specialists to operate it and this is also why this was not an option for this study in Zimbabwe.

vi). Questionnaire screens

Questionnaire screens can identify bilateral permanent hearing loss (BPHL) in excess of 50dBHL and were reported with a sensitivity and specificity ranging from 79-87% and 92-97% respectively (McCormick 1988; Sever et al 1989; Koike et al 1994; Sutton and Scanlon 1999; Fonseca et al 1999; Wirz and Hartley 2001). Questionnaire screens to identify bilateral permanent hearing impairment probably represent the most rapid and least expensive way to screen for hearing loss in children (Sever et al 1989). Depending on audiometric criteria, these questionnaires are reported to be 79-87% accurate for identifying patients with hearing loss defined by the pure-tone audiometry (Koike et al 1994). The questionnaire-hearing screen, advocated by Dube (1995) and validated by this project in Binga, is a quick and simple method that non-specific trained audiological staff could reliably use to screen hearing loss in children in a rural community.

A questionnaire screen can identify deaf children, as reported by Sutton and Scanlon's (1999) study, which compared the sensitivity and the specificity of the health visitor's distraction test (HVDT) versus the health visitor questionnaire (HVQ) in a vigilance programme in West Berkshire, UK. The Health Visitor Distraction Test (HVDT) programme was replaced in West Berkshire in 1989 with a vigilance programme, incorporating a questionnaire adapted from McCormick's (1988) hearing screening questionnaire. The questionnaire asks for parents' observations of the baby's hearing response and behaviour, and was designed to elicit any concerns or possible indicators of hearing problems, including lack of response or lack of double babble. These two screening protocols were compared with PTA to determine their performance to detect permanent congenital deafness (bilateral >50 dB HL) for all children born since 1984. Sixty-two cases met the criteria, giving an estimate of 1.0 per 1000. Performance was similar under the two systems for severe and profound hearing losses (>70 dBHL), but there was a longer tail of late-detected cases of moderate hearing losses (45-70 dBHL) under the vigilance regime using the adapted McCormick (1988) questionnaire used by the health visitors (HVQ) in early identification at <6 months of age as outlined by the National Deaf Children's Society guidelines (40% at age 6 months and 80% at age 12 months) (Sutton and Scanlon 1999; Fonseca et al 1999).

The sensitivity of the "health visitor questionnaire" (HVQ) in referring those with permanent hearing loss was very similar to that of the HVDT (39% and 42% respectively), when compared with the objective tests. Coverage for the questionnaire (HVQ) was approximately 87% but only 78% for the known cases. Referral rate was lower under the vigilance programme, at approximately 3%. The results suggest that a vigilance programme using the HVQ to identify children at-risk is likely to perform as well as the HVDT but no better. Despite subsequent modifications to the HVQ used in the vigilance programme, the poor pickup of moderate hearing losses probably indicates the limitations of parental and professional observation in detecting mild and moderate hearing problems (Sutton and Scanlon 1999; Fonseca et al 1999).

Fonseca et al's (1999) study, also pointed out that identification of permanent hearing loss in children by health visitor distraction tests (HVDT) and health visitor questionnaire (HVQ) protocols do not meet the standards and requirements of the National Deaf Children Society in the UK, which targets 40% and 80% at 6 months and 12 months respectively. Theirs was a collaborative nine-centre study designed to follow the routes to identification of all children up to the age of seven years newly diagnosed with permanent hearing impairment (with $\geq$ 50dBHL) during the period 1993-1994 (Fonseca et al 1999). Ages of identification were compared with the standards set by the National Deaf Children's Society (NDCS), to ascertain whether these targets could be achieved within current service provision (Fonseca et al 1999). Of the 126 children in Fonseca et al's (1999) study, 104 were identified with congenital sensorineural hearing loss: 19% identified by the age of six months and 39% by their first year. These results fell short of the NDCS targets of 40% and 80% respectively and pointed to the need for modifications of the current practices where behavioural screening tests are used in community health programmes.

Fonseca et al's (1999) study recommended the adoption of objective tests such as the ABR and TOAE tests as opposed to the health visitor's distraction test (HVDT) and the Health Visitor Questionnaire (HVQ) in a vigilance programme (Fonseca et al, 1999). The evidence produced by Fonseca et al (1999) supports recent recommendations for universal neonatal screening in the UK (Sutton and Scanlon 1999; Fonseca et al, 1999). In the neonatal screening (ABR) group, 96% were identified under nine months of age compared to around half in the HVDT-only group

(Watkin 1996). In the UK, where universal neonatal screening programmes have been implemented with good coverage alongside the HVDT screen, the extra yield of the HVDT is very low for example 0.1 per 1000 births (Watkin 1996). A selective or 'at-risk' screening regime at age 3-6 is relevant in low-income countries. A questionnaire screen, distraction test or toy tests are within the affordable means of a poor country such as Zimbabwe. It can be argued with evidence from the literature that a questionnaire tool is as sensitive and specific as the Health Visitor Distraction Test (HVDT) or toy tests, and as reliable as the full pure-tone audiological assessments in detecting hearing loss in the 3-6 age group (Sutton and Scanlon 1999; Fonseca et al 1999). A questionnaire hearing screen can incorporate a few appropriate local toys found in different rural settings, is viewed as less complicated and could easily be administered by less specifically trained audiological staff, such as those usually employed by community based rehabilitation (CBR) programmes in Zimbabwe but would need to be validated before such a tool can be used for screening hearing loss in children.

Zamen et al (1993) described the effectiveness of using non-specialists to identify disabilities by using the "Ten Questions Screen", that can identify but is not able to specify details of the 5 major impairment groups (physical, visual, hearing, communication and learning difficulties). The results of these questions were compared with full professional assessments and have been shown to be an effective tool for identifying children with severe disabilities in Bangladesh. Modification of this tool formed the basis of an alternative "Ten Questions", used to identify children with communication disabilities in Eastern Uganda (Hartley 1995). There is no similar low-cost screen to identify deaf children in Zimbabwe (Dube et al 2002).

The high technology audiological assessments were reviewed to give Binga District a wider perspective of hearing screening available with time and an increased resource base. As technology evolves, it should be possible to import and adapt this kind of knowledge since the world has become a global village. Although part of this modern audiometric technology exists in major cities in Zimbabwe, such as Harare, Bulawayo, Gweru and Mutare, it will take some time for it to reach rural areas, the focus of this study (Dube et al 2002).

2.4 Benefits resulting from early identification and early intervention

There is enough evidence indicating that early years are critical in the formative stages of the child's development for shaping intelligence, personality and social behaviour (Berman 2001; Yoshinaga-Itano et al 1996; Apuzzo and Yoshinaga-Itano1995; Watkins 1987)). The contemporary research has also strengthened the argument for early intervention by showing that sensory stimulation from the environment affects the structure and organisation of the neural pathways in the brain during the formative period (Marshall et al 1998). If a child has a hearing-impairment, improved stimulation is required to compensate. It is believed that early education can be beneficial for children with hearing-impairment. Questions to whether there are significant benefits to the child if hearing loss is identified early and appropriate intervention is begun are very important. However, there are several retrospective studies, which demonstrated that early intervention has significant benefits. Berman (2001) argues that these studies have been criticised on the ground that they were not able to control a number of confounding factors as sources of bias.

In spite of few prospective studies looking into benefits of early intervention there is reasonable information indicating that there are benefits associated with early identification and intervention (Driscoll et al 2002; Walzman et al 2002). Some of these benefits were reported by Yoshinaga-Itano et al's (1996) study which compared the language abilities of deaf children identified before 6 months of age (n=46) matched by age of children identified after 6 months of age (n=63) children with bilateral hearing loss ranging from mild to profound, and normally hearing parents. Parent reporting using the Minnesota Child Development Inventory i.e. the Expressive and Comprehension Scales, and the MacArthur Communicative Development Inventories measuring the vocabulary measured language abilities.

Yoshinaga-Itano et al's (1996) study then concluded that children who were identified early and enrolled in home based programmes had high scores both in expression and comprehension scales and had better outcomes on a vocabulary scale (Yoshinaga-Itano et al 1996). In another study, Apuzzo and Yoshinaga-Itano (1995) showed the benefits of early intervention. They recruited 69 deaf children and grouped them according to age of identification Four sample cohorts were similar with respect to age at time of testing, degree of hearing loss and development quotient (DQ).

Children with considerable cognitive delays were excluded. All the children participated in similar early intervention programmes but started at different ages. The outcome data were collected from parents using the Minnesota Child Development Inventory (MCDI) when children were 10 years old. Results were based on covariance adjusted for degree of hearing and cognitive development and the MCDI scores for children identified at age 0-2 months were higher compared to children identified late. Children who were identified at age 25+ months had the lowest scores in these outcomes: language comprehension and expressive language development. Apuzzo and Yoshinaga-Itano's (1995) study reported that children who were identified early and enrolled in home based programmes had high scores both in expression and comprehension scales and had also better outcomes on a vocabulary scale and then concluded that age of identification has an impact on children's general development.

2.4.1 Cost-benefit analysis of screening programmes

The cost analysis is relatively easy but the cost benefit is very difficult because the latter process takes into account a wide cost concept, which constitutes immeasurable elements, which are considered and measured to determine the value of a screening programme. For example, when considering cost analysis of programmes related to early hearing detection and intervention it is important to answer relevant questions. White et al (1998) suggested three questions frequently used in cost-benefit analysis of screening programmes, such as:

- What is the cost of early detection and intervention?
- Which screen is cost-effective?
- What are the cost-benefits derived from the early identification and early intervention programmes?

It is important to determine how much early hearing detection and intervention programmes cost, by analysing the effects of the programmes by using well developed and known methodologies for estimating costs which are relatively straightforward to apply (White et al 1998). Maxon et al (1995) explains that cost effectiveness analysis can only be determined if one programme is being compared to another. It is important to compare whether one screening programme is more cost effective than another programme. If programmes are examined for both the costs and effects the evaluation results should give the indication of programme yields that have a high impact for each unit cost (Maxon et al 1995). According to Sutton and Scanlon (1999), a cost-benefit study can be either comparative or applied to a single programme. In this case, the benefits associated with newborn hearing detection and intervention must be translated into monetary values. A screening programme is said to be cost beneficial if the amount of money spent on the programme is less than the monetary worth of the benefits resulting from that programme, for example, the cost analysis of a TEOAE-based universal hearing-screening programme which was conducted by Weirather et al's (1997) study at Logan Regional Hospital (Utah) in the USA. See Tables 2.4.

Table 2.4: An example of the actual budget costs of operating a TEOAE-based universal newborn hearing-screening programme

Cost items	Cost US$	Total US$
Personnel Costs:		
Screening (65.40 hours worked @ $9.45/hour)	617.84	
Re-screening (9.48 hours worked @ $10.72/hour)	101.65	
Screening management (15.32 hours worked @ $8.94/hour)	136.95	
Programme management (5.23 hours worked @ $10.15/hour)	53.12	
Patient management (12.90 hours worked @ $12.90/hour)	142.54	
Scoring (9.73 hours worked @ $9.90/hour)	116.54	
Sub-total (118.07 hours worker at average $9.90/hour)	**1 168.63**	**1 168.63**
Fringe Benefits (30% of salaries)	350.59	
Supplies, telephone and postage	416.97	
Equipment	446.00	
Hospital overheads (20% of salaries)	476.44	
Subtotal	**1 689.99**	**1 689.99**
Total costs	**2 858.62**	**2 858.62**
Cost per infant screened: US$2 858.62 per 385 babies = US$7.42 per baby		

Adapted from:

- Weirather et al's (1997)
- White et al (1998), in Spivak (pp. 244)
- White (1997). www.infanthearing.org

White et al (1998) reported the actual cost of US$2858.99 incurred by screening 385 babies in a universal new-born screening programme at Logan Regional Hospital, (Utah) in the USA, i.e. it cost about US7.42 per baby (see Table 2.4). White et al (1998) also reported the actual cost of US$110,775 incurred by screening 4,253 babies in a universal newborn at Rhode Island Hearing Assessment Programme, USA. It was then estimated that the cost of screening one baby was about US$26.05. From the data derived from several studies, it can be safely said that the cost of the universal screening programmes in the USA could range from US$7 to US$26 per baby (Maxon et al 1995; Weirather et al's 1997; White 1997; White et al 1998). The computation of the actual costs of a screening programme is a simplistic cost analysis method because a number of items are omitted such as indirect or direct costs borne by parents and the cost of false positives and false negatives, which is deferred to follow-up and tracking, programmes. The anxiety the screening programme cause to parents of the identified deaf children is taken to be irrelevant. As you can imagine, good cost-benefit studies are extremely difficult to do because of the difficulty of assigning monetary value to outcomes such as a year and a half's reading gained or the monetary value to a parent of being able to communicate more effectively with their child (Sutton and Scanlon 1999; Kersner and Wright 2001; Beazley et al 2001; Beazley and Moore 1996).

Where services are not available a screening programme could cause untold problems for families of the confirmed deaf children, for example, Pongprapai et al's (1996) cross-sectional screening survey in rural Thailand, which covered 1836 households and identified 53 children with disabilities after medical confirmation (Pongprapai et al. 1996). According to Pongprapai et al's (1996) study with respect to health seeking behaviour, 20 of the carers claimed that none had been sought citing reasons such as cost, inaccessibility and cultural beliefs. Of the remainder, 53% (n=17) sought traditional treatment only, 35% (n=12) had sought out western treatment and the rest had sought a mixture of both (Pongprapai et al 1996).

Screening programmes do not cost all these elements, which may exert heavy financial burden on families of the diagnosed child with bilateral permanent hearing loss at an early age. Cost benefit analysis of screening programmes could reduce such immeasurable costs born by parents of deaf children and increase the impact of a unit cost item and yield, only if all deaf children who require the appropriately assessed services access them. Since early 1980's WHO has been promoting CBR programmes in Sub-Saharan Africa and the majority of these countries have taken this opportunity in implementing these generic programmes. CBR programmes could create an opportunity to introduce home-based interventions for children identified with bilateral permanent hearing loss with a purpose of improving the accessibility of such services by deaf children to improve their livelihood in rural areas of developing countries.

There are a number of studies, which analysed the cost of early hearing detection and intervention programmes in developed countries. The majority of which are either sample cost estimates or cost-effectiveness analysis as we know that these methods have serious shortfalls related to costing certain immeasurable variables based on unverified self-reports. The computation of costs related to some fringe benefits, and those costs which are incurred: directly and indirectly by parents, for follow up and tracking aspects, for a reduction of sensitivity/specificity of a screen and robustness analysis of the programme are usually ignored (Maxon et al 1995; Sutton and Scanlon 1999; White et al 1998).

Another good example is provided by Stevens et al's (1998) study which evaluated ten different hearing screening programmes in the UK to determine the cost benefits and effectiveness of five screening programmes of targeted high-risk infants: three were universal new-born hearing screening programmes, and two were home-based visitor programmes. The cost of the screening programmes ranged from an average of about US$8 to US$36 per baby born depending whether the screen was screened by the high-risk programmes (8 - 10 US$) or the universal new-born hearing screening programmes (22-24 US$) or the home-visitor programmes (32-36 US$). These results were similar to those reported by studies done in the USA. In Stevens et al's (1997) study the fringe benefits and overheads were computed by using standard weighting (multipliers). It is also important to note that in the ten programmes evaluated by Stevens et al (1997), there was a consistency within the various types of programmes, which makes the results more acceptable. In another study by Bushuizen et al (2001) in the Netherlands they also reported that it cost about 25 and 39 Euros per child to identify permanent hearing loss of 40dBHL or more in the better ear by using otoacoustic emissions (TOAE) and the automated auditory brainstem response (AABR) in a three stage screening protocols respectively. There is a degree of consistency in all these studies reviewed from different countries i.e. in the USA, UK and Netherlands.

There are arguments related to low prevalence of permanent congenital hearing loss in children, which are related to high costs involved to identify a deaf child. For example to identify 3 deaf children with congenital hearing loss you need to screen 1000 children. Despite the fact that the prevalence of permanent congenital hearing loss in children is low (3/1000) it is substantially higher than the prevalence, for example, of hypothyroidism (0.25/1000) and sickle cell diseases (0.2/1000) of which screening is mandatory in USA and some developed countries, which cost about US$25 per blood test (White et al 1998).

The fact that the prevalence of these other diseases is low, the cost of identifying a child with any one of them is about US$41,000 per child, compared to a cost of US$8,683 to identify a child with permanent congenital hearing loss (Stevens et al 1997; White et al 1998). It is worth spending about US$9,000 to identify a child with permanent congenital hearing loss during the first few months of life because of the benefits of early identification; it appears that children identified early will have better cognitive, social and language skills. When evaluating the efficiency of screening programmes, it is also important to show the cost of screening protocols against its performance in early identification of deaf children which is usually measured by the protocol's sensitivity and specificity, thereby benefiting deaf children from education in mainstream classroom instead of special schools.

Is educating deaf children in mainstream less expensive compared with special schools? It is believed that educating deaf children in special schools is very expensive than in mainstream systems with all necessary classroom adjustments done to suit deaf children's needs. The analysis of data from a study conducted by Johnson et al (1993) for the USA Department of Education gives us reasonable information to answer this question. Their assessment produced annual costs of education in a regular mainstream classroom in 1990 of about US$3,383, when the annual costs for a hearing-impaired child in a self contained classroom or special school was between US$9,689 and US$35,780, see Table 2.5 (Johnson et al, 1993). This might translate to the fact that overtime governments both in developed and developing countries would save substantial amounts of money in the educational lifetime of a child as a result of early identification and intervention.

It can be asserted that the most appropriate educational setting for the child is a regular mainstream classroom instead of a boarding special school, which removes them from their natural environment thereby hindering them from being involved and participating in their community's way of life; the challenge for CBR in developing countries (Thomas and Thomas 2001; WHO 1998). Faced with diminishing resources most developing countries are forced to find an alternative to expensive institution-based rehabilitation that is affordable and also provide a coverage which is better than special institutions for the deaf (see Table 2.5).

Peresuh and Ndawi (2000) argue that deaf pupils are affected adversely in poorly equipped ordinary school setting and would experience a less effective curriculum and that the method is too expensive in Zimbabwe. This assertion could be disputed by the fact that deaf children are citizens of a country of which it is the government's responsibility to provide basic needs of all subjects and thereby allocating an adequate budget to cater these needs such as modifying ordinary schools to make them accessible for deaf children, (see Table 2.5 an example of costs for educating deaf children in three settings).

Table 2.5: An example of a cost analysis of educating children with hearing loss in 3 settings as estimated by Johnson et al (1993).

Type of education	Annual cost (US$)
Special school	35,780
Special class	9,689
Ordinary class	3,383

Compiled from the information derived from Johnson et al (1993).

In reality, only 1% of the deaf population is educated in special schools in Zimbabwe (CSO 1995). Johnson et al (1993) however asserts that deaf children would be more than appropriately educated within their local environments. Based on the data about the benefits of early intervention and the costs of early identification programmes, it is very reasonable to expect many deaf children to be educated in local schools (Peresuh and Ndawi 2000; Johnson et al 1993).

2.5 Community participation in audiology service promotion

There are no diagnostic audiololgical services to identify deaf children in community based-rehabilitation (CBR) programmes in rural areas in developing countries. Thomas and Thomas (2002) argue that CBR services are expensive, especially for families with disabled children and that there is a need to find effective and affordable ways of delivering appropriate, accessible and less cost rehabilitation services (include audiological services). Asindua (2002) also, asserts that the World Health Organisation (WHO) CBR model, which was developed in the 1980s, was a top-down alternative to centrally provided specialist rehabilitation services which ignored other issues of community development.

Since the 1980s, WHO has been promoting the implementation of community-based rehabilitation (CBR) programmes in Sub-Saharan countries. CBR services were designed to involve the community people and encouraging them to participate in preventing impairments, rehabilitation of people with disabilities and influencing attitudinal change of the community towards children and adults with disabilities. According to WHO (1980) the bottom structure is where village health and community workers work with the families. The middle level workers are supervisors who could be any professional staff designated to be a supervisor. This cadre is different from one country to another.

In CBR programmes, home-based rehabilitation (HBR) activities are carried out by some trained family members, with the assistance of other members of the family. This is a most complicated linear service delivery model, which involves a lot of volunteerism and teamwork. CBR entails a supervisory team including health workers, welfare workers and members from NGOs such as the Red Cross and Disabled People's Organisations (DPOs). This team determines policy and oversees the activities of the CBR programme in most African countries, which adopted the WHO model (Ndawi 2002).

In Zimbabwe, rehabilitation technicians who are employed by the Ministry of Health and Child Welfare are CBR intermediate level supervisors in charge of village community workers (local supervisors). The rehabilitation technicians are based at district hospitals and are supervised by the district medical officer (Health

Information Services 2001). Each family trainer (a village community worker) is tasked to train and supervise family members who are trained to carry out home-based interventions. A village community worker or any other volunteers directly train the family member with a disability (Ndawi 2002). This linear model of service provision sometimes referred to as the medical model has disempowered disabled people who depended on the professional care and are not actively engaged in decisions pertaining to their lives. The medical model considers disabled people as patients who are required to co-operate and to learn skills provided by village health and community workers to them or their parents for the treatment of impairments, which usually takes place at home. WHO (1980), CBR model did not utilise the community development teamwork opportunities properly because this was never considered as a crucial factor for a successful programme (Asindua 2002).

There is adequate evidence, which shows that community participation and teamwork are central features of a successful service delivery programme. The fact that there are no audiological services available in many Sub-Saharan countries makes it necessary to adapt a WHO, CBR model in considering the development of a community audiology strategy which could integrate an interdisciplinary team concept. This method can be a powerful strategy for early identification and early intervention programmes that could be effective in providing appropriate services for deaf children in rural areas (Asindua 2002; Thomas and Thomas 2002; Neuhauser et al 1998; WHO 1980).

Wright (2001) argues that team building is a central function of an active participatory team approach in working with children such as, when providing audiological services for deaf children. What you always see happening in developing countries is that different professionals would form several teams for networking, sharing information and experience or as a joint effort in trying to accomplish a task. These teams usually embrace a number of professionals. Wright (2001) defines teamwork as a number of individuals working together to accomplish more than they could do by themselves, for example, in providing appropriate services for deaf children in rural areas in developing countries demands services from different institutions and professionals. In development work teamwork is of paramount importance if a participating team has to accomplish planned activities to achieve the intended objectives satisfactorily. The teamwork strategy could have been designed to effectively deliver quality services, which involves activities such as screening and providing appropriate services for deaf children in an urban or rural setting. Because of lack of resources in development, teamwork has been an effective mode of service delivery for centuries in developing countries, where a number of disciplines are working in such a way that they compliment each other. A team is usually formed when there is a need to work together and these can be formally or informally structured with selected co-ordinators, usually with loose written team rules (Ndawi 2002; Wright 2001).

In a WHO (1980) CBR service delivery model, medical institutions found it extremely difficult to incorporate other professionals, such as teachers, pre-school teachers, community development workers and agricultural extension workers. The WHO (1980) CBR model to be effective and being appropriate for developing countries it could be adapted in designing a "community audiology service delivery strategy" (CASDS), which involves a range of different professionals, non-specific trained workers and volunteers in an interdisciplinary team. Mumpande (2002) and Dube et al (2002) suggest that in Zimbabwe an interdisciplinary team would comprise the following cadres:

- community development workers i.e. village community workers; ward co-ordinators, community based distributors, district community development officers, co-operative development officers
- health professionals i.e. village health workers, rehabilitation technicians, clinic nurses, environmental health technicians, community health nurse, physiotherapists and occupational therapists
- educational professionals i.e. primary school teachers and pre-school teachers, district co-ordinators and district education officers
- agricultural professionals i.e. agricultural extension workers, agricultural extension officers and veterinary extension workers
- social and legal development workers i.e. social workers and para-legal assistants, district council social services workers

This is usually a lose team which needs form and shape before meaningful tasks or work could be implemented. One way of providing a framework of a team is the provision of a strong training foundation for volunteers. Ojwang and Hartley (2002) asserts that training of CBR workers in Sub-Saharan Africa has contributed to the improvement of the service provision of the rehabilitation programmes and has resulted into the recognition of involving disabled people and their families as partners. Mumpande (2002) suggests that community audiology programmes should continue to train key professional partners such as pre-school teachers, school heads, health professionals, social workers, community development and village community workers to shape positive culture of these teams which is an aspect usually achieved through training.

Ojwang and Hartley (2002) argue that there are several problems, which have been encountered during the implementation of diploma and certificate training programmes in some African countries. The problems are related to unclear policies and lack of national curriculum development supporting the training of CBR workers. Some countries lack also a political will to improve services for disabled people and hence training of CBR workers is haphazardly co-ordinated by local NGOs and in some countries by poorly structured and inadequately funded government departments (Mpangi 2002; Thomas and Thomas 2001; Boyce et al 2001). Despite lack of formal recognised courses some countries such as Uganda, Namibia, Zimbabwe, Botswana and Malawi have established training programmes for CBR workers. Formal and in-service training courses were developed and have been running successful. The CBR training courses contributed to the growth of CBR programmes in Sub-Saharan countries. The contribution of these training programmes was positively reported by various studies (Ojwango and Hartley 2002). For example, in Uganda, there is a similar one-year diploma course established in mid 1990s through a collaborative training programme with the Uganda National Institute of Special Education (UNISE) and the Centre for International Child Health, Institute of Child Health (University College London) (Ojwango and Hartley 2002). This course is an interdisciplinary programme, which trains candidates drawn from different professional background such as; education, health, community development, social work and some school leavers to work as CBR workers. Community Based Rehabilitation Alliance (COMBRA) a local NGO in Uganda also is involved in training CBR workers in a three-month certificate course which is mainly aiming to improve the candidate's practical skills in rehabilitation at community setting (Kandyomunda et al 2002; Rifkin and Kangere 2002; Ojwango and Hartley 2002) and also, through attending relevant conferences and participating in-situ in-service training workshops conducted at local levels, attending of meetings and the field practical experience, all these activities could be means of promoting and sharing of ideas and used by CBR workers to acquire relevant required practical skills in formal or informal settings (Hartley 2002).

In Zimbabwe, there is a certificate-training course in rehabilitation, which is conducted by the Ministry of Health at Marondera Rehabilitation School. School leavers with 5 general certificate in education (GCE) ordinary level passes (English and 2 science plus any other 2 subjects) are selected for a two-year training programme. The training course gives candidates theoretical knowledge in physiology, anatomy, physio-occupational- and speech therapy and practical skills in general rehabilitation aspects for hospital and community practice. After completing this course they are registered as rehabilitation technicians by the Health Professions Council of Zimbabwe (Ndawi 2002).

The trained rehabilitation technicians are employed by government ministries such as the Ministries of Health and Child Welfare and Labour, Manpower and Social Development, Defence, Home Affairs, Local Authorities such as Rural District Councils, NGOs such as Red Cross, Jairos Jiri Association and Council for the Blind and Parastatals and the private sector such as the National Railways of Zimbabwe and the Workman's Compensation. As already said, CBR programmes use rehabilitation technician to train and supervise family members and village health workers respectively in urban or rural communities (Ndawi 2002). Ndawi (2002) asserts that the CBR model of rehabilitation service delivery is a community responsibility co-ordinated by well-organised teams, and he said,

"rehabilitation is no longer the task of specialists, but a responsibility of the whole community. Instead of having one person at the community level to deal with all aspects of rehabilitation, more people are involved (Ndawi 2002 pp. 99).

For CBR collaboration teams to function smoothly and realise their goals there is a need for them to develop strong regulatory, facilitatory and sustainable structures, which may need a well co-ordinated and monitored activities, backed up by government policies and regulations (Ndawi 2002).

2.5.1 Importance and gains of working in a team

When different professionals in health, education and social services work together in a team for screening, management of ear diseases and rehabilitation of deaf children much more is accomplished and deaf children benefit tremendously from such concerted efforts from different expertise. Neuhauser et al (1998) argue that working as a team brings continuity of an approach that ensures that deaf children and their parents receive reinforced and consistent messages and this encourages parents to participate into screening and rehabilitation programmes even at their homes. This approach is only successful when a central and efficient co-ordinator is selected who is able to assess the environment, plans in consultation with all stakeholders and is being accessible to all team members. Rifkin and Kangere (2002) assert that participation of different professional teams in CBR in Africa, especially where life situations are threatening particularly for deaf children and their families could benefit more when these collaborating professionals work together to bring more expertise and notable experience.

New insights always emerge when work is organised in a way that co-operation, collaboration and networking teams are formed that usually influence the management strategies when the new knowledge and information that they had gained from working as a team. Mumpade (2002) asserts that knowledge and skills gained from short courses and the experience gained from the field can contribute to continuing professional development and making the team even stronger.

As we all know that a deaf child has various needs of which a teacher or a nurse or a village community worker is inadequate to meet all these needs. For example, the children identified with otitis media would require medical intervention, which is provided by health professionals such a nurse at local clinics, which are found in rural areas in Zimbabwe. A deaf child is usually referred for educational rehabilitation, which involves a pre- or primary school teacher. A social worker usually helps to understand parents' contextual views on screening and benefits derived from early identification and early intervention programmes.

When a team understands a broader aspects of a deaf child's environment, the early intervention programmes are usually in a better position in setting realistic goals and strategy which are effective in delivering appropriate services and also motivating, parents and the team members. It is of paramount importance when considering initiation of an early identification and early intervention to take stock of all human resources available and mobilise these resources to build strong linkages.

Different professionals and the rural community leadership are keen to participate in interventions where they believe there might get rewards for belonging to a collaboration network. This is the most challenging aspect most projects overlook during planning and implementation stages. Benefits are paramount incentives in persuading professionals to participate in a collaborative programme where line management structures are loosely applicable. For example, village community workers in Binga, Zimbabwe are volunteers and get very little financial rewards from government. There are no formal powers given to rehabilitation technicians or any other community workers to directly give a village community worker orders to do a piece of work, especially in a screening programme for early identification and early intervention for deaf children because they are volunteers and the government has no enforceable policy and legal instruments against them.

There are several reasons different professionals would like to participate in voluntary work such as in early identification and early intervention programmes for deaf children in a rural setting such as in Binga, Zimbabwe. Voluntary teams are sustainable by their members who would like to participate in a collaborative group as long as they view their membership as being of benefit. For example benefits derived by village community workers and pre-school teachers from a well organised early identification and early intervention programmes are usually factors such as acquiring knowledge, receiving recognition, gaining new friends, having a heart to contribute to the community, anticipating get future employment, getting a good reference for the future work prospects or looking for academically prospects.

2.5.2 Methods of working in teams

There are several ways of working as a team: i.e. one method is when professionals with separate programmes working together making them more successful, or groups or networks jointly offering specialised tasks in a defined role. These could involve some flexibility in order to work together well such as when team members are taking a facilitation position, while letting other professionals deal directly with the deaf children. For example, this method could involve two or more organisations such as when Ministries of Education and Health in Binga, Zimbabwe are implementing an early identification and early intervention programme e.g. one of these ministries providing consultancy work. The collaboration could be on training or other specific tasks deemed important by both parties.

There are also a number of factors that can make people want to work together, especially when different professionals employed by different organisations such as the Ministry of Health and Education. Organisations have different priorities, needs and work codes governing their work ethics and conduct. There are obvious differences when people are working in groups whether being small or big ones because of their different priorities and needs, usually lack of clarity of roles and overlapping of these may create friction. To avoid the apparent friction there is a need to clarify these roles. Clear definitions of roles are not easy, especially in a programme, which is badly planned and inefficiently co-ordinated. In a screening programme where a low cost screen is used it should be clear whose role is to use which tool and knowing also the referral system which is working to motivate and creating a synergy in such collaborative programmes, the factor which is central to a community-based audiology in Binga, Zimbabwe.

2.6 Implications for screening programmes

There are implications about screening programmes in developing countries such as Zimbabwe recommending that all babies be screened for hearing loss before discharge from hospital. Despite the rapid increase in hospital-based screening programmes in developed countries in the 1990s provided clear evidence about the challenges of the practicality of universal screening programmes. Many questions remained unanswered about the efficiency and effectiveness of such programmes, which include those, related to:

- availability of physiological testing equipment
- availability of trained staff
- coverage and referral rates,
- effects of universal new-born hearing screen on age of identification,
- effects on parents and
- follow-up.

Questions are raised about whether hearing screening programmes really do reduce the age at which deaf children are identified. The critics argue that they are no screening programmes, which have solved the problems of follow up and the diagnosis of very young children, because they are no good data suggesting a substantial reduction of the age of identification (Parving and Salomon 1996). Parving and Salomon (1996) assert that the universal newborn hearing screening would identify about 60% of deaf children before 12 months of age. The other issue related to the implication of screening programmes is whether these programmes create unacceptable levels of parental anxiety or disruption of family functioning. In spite of the fact that the screened children are accurately identified with or without hearing loss parents go through a process of anxiety which therefore makes it very important to provide support services for parents of deaf children such as; counselling and provision of adequate and accessible information to make them cope with their children's disabilities. Clayton's (1992), and Hergils and Hergils' (2000) argue that there are levels of parental anxiety created by a hearing screening programme results such as:

False-positive results:

- Negative effects of parent-child bonding such as rejection or over-protection
- Anger, resentment or confusion when child is confirmed
- Lingering concerns about whether child's hearing is normal

False-negative results:

- Inappropriate confidence that child hears normally, thus delaying identification

True-positive results:

- Emotional stress during time of emerging parent-child relationship
- Incomplete or inaccurate information may be used to make future reproductive decisions

Outcomes of the screening programme have great implications and therefore they need careful planning for and providing resources for interventions programmes for deaf children. Parents are supportive of genuine effort to identify deaf children early for early intervention (Hergils and Hergils 2000). Neonatal follow-up of those who fail a screen for diagnostic testing has considerable parental dropout at each level and this is shown by Barringer and Mauk's (1997) study which reported that about 89% of the parents they interviewed preferred having a new-born hearing screening programme but were dissatisfied with the age at which their children's hearing loss was diagnostic confirmed.

It is disappointing to note that the majority of screening programmes identify follow-up and tracking as the biggest challenge related to the early identification of hearing loss. It is widely accepted that screening itself has proven to be relatively easy, but completing the process through diagnosis and appropriate early intervention remains a substantial challenge because this depends on various factors that include geographical and socio-economic circumstances, transportation (especially in rural areas), cultural and linguistic diversity, communication difficulties, lack of adequate programme funding and parental awareness and motivation (Mahoney and Eichwald

1987; Clayton 1992; Uzcategui 1997; Hergils and Hergils 2000). Hergils and Hergils (2000) suggest that it is very importance to consider the parental concerns when screening hearing loss in children.

It is not advisable to screen children without ensuring that there are services available for the identified deaf children (Haggard 1992; Hergils and Hergils 2000). In Zimbabwe, there are pre-school services where deaf children could be enrolled and this justifies the need to screen hearing loss in children aged 3 because services for this age group are available in rural areas. As said before the Ministry of Education policy on education in Zimbabwe (1997) is to educate every child, which includes the deaf. Although, the universal screening is recommended in developed countries for identifying bilateral permanent hearing loss in infants for the purpose of initiating rehabilitation interventions, where such policies are not applicable and there are no audiological services or alternatives available to identify bilateral permanent hearing loss in children such as in developing countries, it is advisable to screen the at-risk children as being suggested by the York University (1997) which manifest the following factors summarised in Box 2.1.

Box 2.1: Risk factors for sensorineural hearing loss adapted from York University (1997)

1. Family history of hereditary childhood sensorineural hearing loss;
2. Congenital perinatal infection with herpes, syphilis, rubella, cytomegalovirus, or toxoplasmosis;
3. Malformations involving the head or neck (e.g., dysmorphic and syndromal abnormalities, cleft palate, abnormal pinna);
4. Birth weight below 1,500g; bacterial meningitis; hyperbilirubinemia requiring exchange transfusion;
5. Severe perinatal asphyxia (Apgar scores of 0-4 at 1 minute or 0-6 at 5 minutes, absence of spontaneous respirations for 10 minutes, or hypotonia at 2 hours of age);
6. Ototoxic medications; and findings associated with a syndrome known to include hearing loss

Compiled from the information derived from York University (1997)

York University's (1997) list of the "risk factors" for congenital or perinatally acquired hearing loss can be adapted to include parental concerns and used for screening programmes in developing countries. Attitudes held by both physicians and society towards deaf individuals including in Zimbabwe are changing over time. Various associations and interested groups including Non Governmental

Organisations (NGOs) now offer support to individuals identified as deaf by promoting their full participation in society, and seek to preserve and expand deaf awareness, deaf culture, and deaf heritage (Okech 2002; Kisanji 2002; Mushoriwa 2002).

2.6.1 Advisability of screening hearing loss

The consensus has also been widely accepted in a public health context that pre-lingual impairment needs to be identified early by some sort of screening process (Berman 2001). Theoretically, the greatest benefit from hearing screening comes from detecting moderate to severe hearing impairment in children between birth and 3 years of age. If screening for hearing-impairment is performed near the time of birth, followed by a definitive diagnosis, the choice of treatment and treatment success will depend on the aetiology of the hearing loss and more importantly on what is available and what is deemed "right" by the cultural context. This is possible and can be effectively applied where the technological advancement is a reality. Pre-school intervention can prepare hearing-impaired children for their educational needs at school. Effective rehabilitation of these children would depend on the degree of hearing loss and, among other things:

a) management of the impairment and
b) management of the disability consequences

Despite such technological developments in developed countries, it will take some time for them to be developed in low-income countries. Even though technological importation is rapidly growing in African countries such as Zimbabwe, in rural areas where 80% of the poor deaf population live are far from the modern services brought about by these changes (Kandyomunda et al 2002; Schneider et al 2002; McPherson and Swart 1997; Jones 1974; CSO 1992/1995).

2.6.2 Consideration of hearing screening programmes in Zimbabwe

It has been recognised in Zimbabwe that a high proportion of mothers with children with hearing-impairment are seeking some communication rehabilitation services from CBR programmes (Zindi 1996; Chimedza 2001; Mushoriwa 2001; Mumpande 2002, Dube et al 2002) and this indicates a need for community workers to develop skills and knowledge to meet these needs.

Parents of deaf children are also positive towards placement of their children in ordinary schools but they usually show varied knowledge, attitudes and practice (Urombo 2001; Chege 2001; Hartley and Wirz 2002). On the whole, the possible solution for current CBR programmes to be able to address special needs for deaf children appears to be an appropriate training intervention for teachers and community workers in the area of communication skills and sign language (Hartley and Wirz 2002; Kandyomunda et al 2002; Schneider et al 2002; Zindi 1996; Chimedza 2001; Hartley 1998; Mushoriwa 2001; Eleweke 2001). Hartley and Wirz (2002) argue that specialists services are limited and therefore the governments should encourage the participation of community groups to work together with professionals to develop new and innovative initiatives such as the community-based audiology (CBA) programmes and said,

> *"Professionals could give consideration to supporting the role , which can be played by non-specialists and community personnel in effective intervention of communication disability. Listening to the parent's perspectives ……and involving parents and families at the planning stage of rehabilitation in a partnership rather than as passive receivers of the services offered"* (Hartley and Wirz 2002 pp. 1554).

At the moment, there is no systematic screening programme in Zimbabwe. But possibilities exist to consider introducing such programmes since the infrastructure is in place that can support such initiatives (Dube et al 2002; Mumpande 2002). The hearing screening services available for children are based on networking with service providers, such as:

- special schools/units, resource units at mainstream schools,
- the under fives clinics, the rehabilitation departments established at district hospitals by ministry of health and child welfare,
- social welfare departments at district level (they pay school fees for poor pupils in secondary schools and pay for aids and appliances for disabled children),
- village development and political structures and
- traditional community leadership.

These structures are well established in the country's rural areas. The Zimbabwe Education Act of 1987 states that 'every child in Zimbabwe shall have the right to school education' (Zimbabwe Education Act 1987). In addition, circular 'P36' of the Ministry of Education (1992) states that:

> *'A child with special needs may be allowed to remain in school for one or two more years in order to complete the curriculum and... education shall be compulsory'* (Nyika, 1997: pp 30).

As stated before, various studies carried out in developing and developed countries have found that some low cost hearing screens were used. The studies conducted in the UK established that these low cost screens are used in detecting hearing loss in children, for example:

- Questionnaires (McCormick 1993; Haggard 1993)
- Health Visitor's Distraction Test (Haggard 1993)
- Toy Tests (Bellman, Mahon and Triggs 1996)

Some of the findings of these studies indicated low sensitivity in some behavioural screens, while others indicated high sensitivity results (Haggard 1993; Sutton and Scanlon 1999) However, Wirz et al's (2001) study finds a questionnaire screen reliable (with a 97% sensitivity and 94% specificity) in detecting severe/profound hearing loss in Brazil which is the screen adapted by this study and pilot tested in

Binga, Zimbabwe. Box 2:2 gives examples of questions that could be used to identify deaf children.

Box 2:2 Examples of questions that could be used to screen hearing in children

a) *At 0-4 months:*
When the infant was sleeping quietly, did sudden noises awaken the baby momentarily? Did the infant jump at sudden loud noises?

b) *At 4-7 months*:
Did the baby begin at 4 months to turn toward sounds that were out of sight? Did the baby repetitively babble a large variety of sounds at 5 and 6 months? By 7 months did the baby turn directly to sounds or voices that were out of sight? What kinds of babbling sounds were made at 6 and 7 months? Could the baby sit alone at six months?

c) *At 7-9 months*:
Did the baby turn to find the source of sounds out of direct sight? Did the baby gurgle or coo to voices or sounds that the baby could not see? Did the baby make sounds with rising and falling inflections?

d) *At 9-13 months*:
Did the baby turn and find a sound coming from behind? Did the baby begin to imitate some sounds and have a large variety of different sounds? Were some of them consonant sounds (buh, guh, and duh)? Did the baby say "ma-ma-ma-ma" or just "mama?" What specific sounds did the baby produce/say?

e) *At 13-24 months*:
Did the toddler hear you when you called from another room? Did the toddler make a noise in response or come to you? What words or sounds other than "mama" were made? Did the voice sound normal?

Compiled from suggested by McCormick (1993), Northern and Downs (1991) and Haggard (1993).

Some of the questions listed in Box 2.2 were examined, revised and included in Dube's (1995) "Questionnaire" screen and were later refined by Wirz and Lichtig (1998). Although a lot of work has been done to date in developed countries, more studies need to be conducted to ascertain the sensitivity and specificity of questionnaire hearing screens in identifying deaf children in varied rural areas in developing countries (Dube 1995). There is no screening for the pre-school age group in rural areas in Zimbabwe (Dube et al 2002). There are also poor services available in rural areas for the rehabilitation of children with hearing impairment. For instance, in Binga, pre-and primary school teachers usually notice hearing problems in school children but have no means to confirm their suspicions (Binga Health Information Services 2001). Literature suggests that there is a general lack of data on hearing impairment in children in Africa (Chege 2000). Yet, the cost of deafness to individual children, their families and the community in general can be enormous. Provision of services to, and management of, such children should reduce this cost so that in the long-term such intervention would be justified (Haggard 1993; Beasley and Moore 1995). Many children with hearing impairments, especially those with mild and moderate hearing loss are not identified and do not benefit from the Community Based Rehabilitation (CBR) programmes in Binga, Zimbabwe (Binga Health Information Services 2001). There are reasons, such as:

- There is no clear national policy for screening hearing loss.
- There is no simple screening protocol/tool that could be used by local level CBR workers and rehabilitation technicians targeting children in rural areas in Zimbabwe.
- CBR workers, rehabilitation technicians and primary health care nurses are not adequately trained to screen hearing loss in young children.
- Inadequate resource allocation to health, education and social service ministries. As a result of limited resources these ministries would push the needs of deaf children to the margin.

In the USA and UK children may need to be screened earlier so that they can access special services. It may not be appropriate in Zimbabwe where these services do not exist. Nevertheless, Zimbabwe has developed pre-school services for children aged 3-6 years. If children are identified with hearing loss at this age there is an opportunity to enrol deaf children at local pre-schools where appropriate communication and language development skills are taught. It is realistic for an intervention to commence from around 3 years because pre-school services exist in rural Zimbabwe (Kandyomunda et al 2002; Schneider et al 2002). There are also support services provided by NGOs in rural areas where the Ministries of Health and Education implement programmes such as the CBR (Kandyomunda et al 2002; Schneider et al 2002). Rehabilitation technicians and special trained teachers support village community workers in the identification and rehabilitation of the identified disabled children such as the deaf in their respective villages. However, Dube's (1995), Mumpande's (2002) and Dube et al's (2002) studies have recommended an introduction of a screening programme to identify deaf children in Zimbabwe by using low cost screens.

Mumpande's (2002) study looked into knowledge, attitudes and practices (KAP) of service providers towards the inclusion of deaf children aged 3-8 years in mainstream educational activities in Binga District, Zimbabwe (n=72) and suggested that teachers and village community workers need more information on screening and rehabilitation of deaf children in the mainstream education in Binga. Dube et al's (2002) study asserts that low cost interventions are being implemented by existing agencies in developing countries haphazardly, therefore they is a need to influence service providers to develop policies towards the provision of appropriate and well co-ordinated services for deaf children. Dube et al (2002) therefore recommended that:

> *"interventions to facilitate a change of negative attitudes towards children with hearing impairment should be introduced and these community programmes should aim at identifying and integrating deaf children into mainstream activities in the communities"* (Dube et al 2002 pp. 52)

Dube's (1995) "Questionnaire" screen aims especially at identifying children with permanent bilateral hearing impairments and relates to the needs identified and evaluated by this study in Binga, Zimbabwe versus the Brazil study conducted by Wirz and Lichtig (1998) in the University of Sao Paulo Audiological Clinic. Also the Brazil study from a specialised high technological university teaching audiological clinic (which is compared to Binga, Zimbabwe from a non-specialist rural community health services) finds this questionnaire highly sensitive for identifying children with severe or profound hearing impairment (95% sensitivity and 97% specificity) against normal hearing children but regrettably had insufficient children with mild and moderate hearing losses to endorse its reliability in detecting moderate hearing loss (Wirz and Lichtig 1998; Wirz et al 2001). Some of these screens can be adapted for use in Zimbabwe, see Table 2.6.

Table 2.6: Summary of key-screening tests used to detect permanent childhood hearing-impairment in the UK

Type of tests		Comments
1(a)	Infant distraction test (IDT)	The IDT, with calibrated sound source are called the BeST test. The early detection of bilateral permanent hearing loss (>50 dB HL), according to the National Deaf Children Society (NDCS) recommendation: i.e. 40% identified at age 6 months and 80% at age 12 months. The sensitivity is about 42% in children below 18 months and about 87% when they are aged +18 months and cost about £25 to £30 per child, including follow-up (Stevens et al 1998; Sutton and Scanlon 1999).
1(b)	Traditional Health Visitor distraction test (HVDT), universal in most districts	Test carried out at 6-9 months, usually in protected time. The sensitivity is about 42% and about 87% in children aged 18 months and cost about £25 to £30 per child, including follow-up (Stevens et al 1998; Sutton and Scanlon 1999).
2	Health Visitor Questionnaire screen (HVQ)	The screening questionnaire performance in early detection as specified by NDCS has a sensitivity of about 39% compared with the physiological tests in identifying of bilateral permanent congenital deafness when children are aged below 18 months (bilateral <50 dBHL). At the age of 3 years the sensitivity of the questionnaire screen to identify moderately severe to profound hearing losses (>50 dBHL) is about 79% and 89% and cost about £20 to £25 (Stevens et al 1998; Sutton and Scanlon, 1999).
3	Toy Tests	The Toy Tests for screening bilateral permanent hearing loss (>50dBHL), is about 100 and 94% at age 3 years (Bellman et al 1996, McComick 1993).
4	Pure-tone audiometry (PTA)	The screen is used when children are developmentally read for turn taking, usually it is at the age of ±36 months. The majority of children are PTA ready at 48 months and has a sensitivity and specificity of 92% and 95% and cost about $20 to £25 per child (Watkins 1996).
5	Transient Evoked Otoacoustic Emissions (TEOAE)	A quick test carried out within days of birth. MLS TEOAE is a new, very quick version of TEOAE that may have advantages in noisy situations. It measures acoustic energy generated by the healthy cochlea in response to wide band clicks using a lightweight ear-canal probe. It cost £8 to £14 per test. It is presently widely used for universal neonatal screening (Stevens et al 1998).
6	Auditory Brainstem Response (ABR)	A test carried out within days of birth. Wide band clicks are presented to one ear and the resulting electrical potentials of the early auditory pathways are measured using surface electrodes. Some ABR machines make pass or refer decisions, others need trained operators. High recurrent costs or long test time on some implementations. Presently widely used in universal neonatal screening and cost £8 to £14 per baby (Stevens et al 1998).

Compiled from the information derived from Sutton and Scanlon (1999), Watkins (1996) and Stevens et al (1999), Bellman et al (1996) and McComick (1993).

These screens have different levels of performance (sensitivity and specificity) and costs per test, see Table 2.6. The HVDT is an expensive screen when compared with other screens. However, the full cost of health visitor (HV) time does not allow for the fact that a HV may be visiting the home anyway. If done in conjunction with several other activities, its accuracy and therefore its value, is likely to be reduced. A HVDT or HVQ as operated in the UK are expensive protocols because well-trained health visitors use them, see Table 2.6. The high costs of using these screens could be reduced, for example if village community workers (they are given an honorarium amount of less than a pound sterling (£) per month) are used to screen hearing loss in children in rural Zimbabwe. Village community workers are the primary staff cadres in CBR programmes in rural villages. CBR programmes in rural Zimbabwe find it difficult to identify children with hearing loss at early stages of their life. Their identification in the community is often by chance, by responding to mothers' intuition about their children's hearing. Mothers and carers visit health centres intermittently complaining that their children are not able to hear.

There is substantial and convincing evidence suggesting that bilateral permanent congenital hearing losses (PCHL) have serious negative consequences for children's development and success in school. In recent years, there has been increasing evidence that mild bilateral and unilateral permanent and fluctuating conductive losses can also have serious negative consequences for children (Maxon et al 1997; Watkin et al 1995). The pure-tone screen (PT) is an appropriate screen for most children who are developmentally progressing well at their chronological age of 36 months. These children are turn taking and would co-operate during screening. With these assumptions the PT was therefore adopted as a reference test (gold standard) for this study. However, it is practically impossible to get reliable results with the PT screen in children below the age of 24 months. For example, Watkin's (1996) observations have been reported stating that testing children below the age of 30 months with pure-tone audiometry is more difficult or not feasible because it depends on the developmental ability of an individual child and these observations were equally reported by many studies (Swart et al 1995; Fonsceca et al 1999; McCormick 1993; Haggard 1993; Haggard 1993; Bellman, Mahon and Triggs 1996).

However, Auditory Brainstem Response (ABR) and Transient-evoked Otoacoustic missions (TEOAE) are currently viewed as the standard for physiological testing in infancy and the most accurate method available for determining hearing function (Smith et al 1992). Sensitivity rates have been reported to be 97-100% and specificity rates 96-98% in comparison with behavioural testing measures as reported by several studies (Abdo et al 1993; Allum 2000; Apuzzo and Yoshinaga-Itano 1995; Hyde et al 1990; Davis 1997; Maxon 1997; White et al 1998; Robinette 2000; Mann 2001).

As such a universal screening test, ABR (or modified ABR) is unsuitable in Zimbabwean context because of the need for costly equipment and trained operators in all community hospitals and birthing centres, and therefore could not be recommended as a screening test in rural areas. In Zimbabwe, where modern technology in audiology is not accessible to rural people and might take some time to be realised, there is a need to develop a low-technological, low-cost and reliable hearing screen in detecting sensorineural hearing loss in young children. It is possible to use less specific trained audiological primary health care workers to identify deaf children in the community by using a validated questionnaire-hearing screen. Depending on audiometric criteria used, questionnaire hearing screens are reported to be 60-79% accurate for identifying children with hearing loss defined by pure-tone audiometry above 40 dBHL across the frequencies: 0.5k, 1k, 2k and 4k (Koike et al 1994; Haggard 1993).

There are several screening tools, which exist; the key screens widely used are shown in Table 2.6. Some screens are more effective than others as indicated in Table 2.6. However, there are problems of selecting and adapting the most efficient physiological or behavioural screens widely used in developed countries for either service provision or research purposes in developing countries. Some work has been done in screening in Sub-Saharan countries. The development of a low-cost hearing screen would be a good idea in Zimbabwe.

2.6.3 The way forward

This study developed a new adaptation of Dube (1995) screen for comparison with pure-tone screening, which was also the basis of the Brazilian study (Wirz et al 2001). Wirz and Hartely (2001) reported that the adapted Dube's (1995) study hearing screen had a high sensitivity and specificity of 97% and 94% respectively in identifying deaf children with severe and profound hearing loss (in excess of +65dBHL) in age groups of above 3 years. Despite the fact this screen was adapted and evaluated in Brazil and was reported with a high sensitivity of 97% and specificity of 94% in identifying severe/profound hearing loss in children aged 3 to 6, this does not endorse it as an appropriate screen for Zimbabwean situation because the two countries are culturally different from each other and more importantly the Brazilian study was hospital-based where high full pure-tone audiological diagnostic assessments were conducted versus the Zimbabwean community-based study where only a pure-tone reference screen could be possible. There are also several questionnaire screens, which were used in developed countries, but none of these screens were developed and validated for use in Zimbabwe and these could not be used accurately in screening children aged 3-6 in Binga District. Some of these screens were meant for younger children ($\leq$2-year olds) (McCormick1993) and were not validated for use in rural areas in developing countries.

It was viewed important to adapt and adopt Dube's (1995) questions for this study to ascertain its sensitivity and specificity in identifying bilateral permanent hearing loss in children (BPHL) as compared with the pure-tone (PT) screen in rural Zimbabwe. For a screening tool to be used in programmes it is of paramount importance to establish its reliability. This is very important work, which determines the accuracy of a screen in measuring its validity in identifying permanent hearing loss in children. A performance of a screen gives indications of its accuracy. Higher levels of reliability also indicate less error variance and consequently high correspondence between true positive cases of hearing loss and true negatives identified by a screen as opposed to false positives and false negatives.

The internal consistency reliability of the screen is necessary. A reliability measure assesses the degree to which questions and observations contained in the "Questionnaire" screen are constant in identifying bilateral permanent congenital hearing loss in children. In this study, therefore data collected by the "Questionnaire" screen are compared with those collected by the pure-tone (PT) screen (the gold standard) in Binga, Zimbabwe (Kirkwood 1994).

CHAPTER 3

METHODS

Chapter 3

3.0 Methods

The methods of this study are divided into two parts:
"Part A" describes the methods employed in collecting data used to evaluate the performance of the "Questionnaire" screen. Data was collected and analysed to determine the performance of the "Questionnaire" screen in identifying permanent hearing loss in young children.

"Part B" describes the methods used to collect data 12 months later that was used to evaluate a simple training programme conducted for pre-and primary school teachers, village community workers, health workers and social workers on screening and rehabilitation of hearing-impaired children in the community during 2000 to 2001. "Part B" data collection was conducted to find out if knowledge, attitudes and practice of the course participants translated into action in integrating deaf children in ordinary schools in the study wards. This was collected for the purpose of providing appropriate services for the identified deaf children. Training of service providers in the study wards was conducted for the purpose of fulfilling an ethical issue of providing a service for the identified deaf children in the study area.

Part A

3.1 Rationale of the study

There is evidence in the literature pointing to a need to develop and evaluate a simple low cost hearing tool to identify deaf children in developing countries (Hosford et al, 1987; Flipsen, 1995; Haggard and Hughes, 1991). This need is also an expression of community need in rural areas of Zimbabwe where community and institutional-based rehabilitation programmes serve fewer than 3% of deaf children (Peresuh and Ndawi, 2000). In Binga, this situation is exacerbated by the fact that there is a lack of resources to meet the needs of disabled children of which community programmes serve less than 1% of deaf children (Binga Hospital, 2001).

3.2 Aim of the study

The focus of this project was to identify sensorineural deafness in children aged 36-72 months in Binga district, Zimbabwe.

3.2.1 Objectives

The objectives of the study were:

- To validate the "Questionnaire" screen in identifying hearing loss in children aged 36-72 months in excess of 50dBHL of the better ear
- To test the reliability of the "Questionnaire" screen

3.2.2 Hypothesis

It was hypothesised that the "Questionnaire" screen can identify 60% of children with permanent hearing loss in excess of 50dBHL averaged across the frequencies' 0.5k, 1k, 2k and 4k defined by pure-tone audiometric results of the better ear.

The null hypothesis (Ho): was that there is no difference between the performance of the "Questionnaire" screen and the pure-tone screen in identifying children with permanent hearing loss in excess of 50dBHL averaged across the frequencies' 0.5k, 1k, 2k and 4k of the better ear.

3.3 Selection of the study location

The researcher was invited to a meeting on 30 March 2000 with works and social service committee members (9 councillors) of Binga Rural District Council, which has a total population of 80,000 people (CSO, 1992). The meeting was tasked to select the study location. During the meeting it was decided that a fair selection of wards was to use the ratio 1:3 (Siabuwa Communal Land Wards is to Manjolo Communal Land Wards) i.e. 1 ward from Siabuwa and 3 wards from Manjolo, plus 1 reserve ward from Siabuwa and 2 from Manjolo.

This meeting considered the population distribution in the two communal lands. Numbered cards (representing ward names) were placed in two boxes. One box contained cards representing wards in Siabuwa Communal Land and the other box with cards representing wards in Manjolo Communal Land. A councillor was asked to pick one card from a box lifted above his/her head while seated on a chair. Each councillor was given one chance to pick a card.

Using this method of random selection four operational and two reserve wards were selected from Siabuwa and Manjolo Communal Lands and the study was located in five randomly selected wards of Binga District.

The next section focuses on describing the procedural steps followed during data collection.

3.3.1 Study location

Binga was chosen as a project district in Matabeleland North Province because it was viewed as one of the poorest in the region (UNDP 1998). There are 3 communal areas and 21 wards making up Binga district council area. The project worked in 5 wards of 2 communal areas situated in a dry mountainous region of the Zambezi valley with inadequate and unwholesome water supplies.

There are 21 administrative wards in Binga District. According to the 1992 census, a total of 80,000 people live in the three communal lands of the district, namely:

- Siabuwa,

- Manjolo and
- Busi Communal Lands

Busi communal land was excluded from the study location because there are several tribes living in this area, who speak other languages rather than the Tonga spoken by the majority of Binga inhabitants. Table 3.1 presents the ward and population distribution in the selected study wards. These wards were randomly selected, namely: Nagangala/Sinampande, Sikalenge, Lubu, Muchesu and Sianzyundu.
See Table 3.1 below.

Table 3.1: Selected Wards (CSO, 1992)

	Siabuwa Communal Land	**Manjolo Communal Land**	
Ward Number	**Ward Name**	**Ward Name**	**Ward Population**
1**		Sianzyundu	5386
2**		Simatelele	2185
4		Lubu	2780
5		Muchesu	2181
15*	Sinansengwe		1860
17		Sikalenge	3968
21	Sinampande		3463
Selected wards total population			**21823**

Notes:

** denotes reserve wards*

Table 3.1 shows the communal areas and wards making up the total area of Binga Rural District Council. It also shows how the study wards were selected as follows:

- In Siabuwa Communal Land: one ward number 21 (Sinampande) plus one reserve ward number 15* (Sinansengwe) were selected.
- In Manjolo Communal Land: three wards, numbers: 4 (Lubu), 17 (Sikalenge) and 5 (Muchesu) plus two reserve wards, numbers: 2** (Simatelele) and 1** (Sianzyundu) were selected.

There are about 22 000 people living in the study wards (CSO, 1992).

3.3.2 Topography

Binga district is a wild life area surrounded by Chizarira National Park, one of the biggest parks in Zimbabwe (see Picture 3.1, one of the dry mountain ranges in one of the study wards).

Picture 3.1: The dry mountain ranges in one of the study wards

Picture 3.1 above is one of the project locations taken at Muchesu ward, south of Binga town. The area is mountainous and very dry with a rough road running across it. The crops grown there are mainly munga and finger millet which provide a staple diet for the majority of the inhabitants (see map 3.1).

MAP 3.1: MAP OF ZIMBABWE: LOCATION OF BINGA DISTRICT IN MATABELELAND NORTH PROVINCE

(Geography and Map of Zimbabwe *http://geography.about.com/library/cia/blczimbabwe.htm*)

Image removed due to third party copyright

These are locations of project wards (in rural areas of Binga).

3.4 Recruitment of study subjects

The recruitment process took several steps. Firstly, all the children aged 36-72 months were enumerated. Secondly, the "at-risk" children were identified and enrolled in the study as the "at-risk" group that was matched age and sex with a control group. The researcher developed a "Failing and Following" recruitment method from the input contributed by the supervisors. The "Failing and Following" criterion which was employed for the recruitment of the subjects to test this hypothesis, is explained below.

3.4.1 "Failing and Following" method

There are problems in enrolling a sample with a relatively low prevalence condition such as permanent hearing loss. Self-referral snowballing methods were considered and rejected because it was not feasible to get a large number of subjects within a limited time. Eventually, a new method was designed by the researcher and called the "Failing and Following". The method uses the "Two-questions" to identify "Failing and Following" children. The "Failing and Following" methodology was designed for recruiting subjects for this study. It targeted a child more likely to be deaf who was matched with the next child of the same age and sex identified as not at-risk.

The researcher formulated these "Two-questions" to identify the at-risk children ("Failing and Following" children). See Box 3.1 below

Box 3.1: "Two-questions" to identify "Failing and Following" children

i) Does the child have difficulties or problems in speaking?	***Yes*** ☐	***No*** ☐
ii) Did the child ever have pus/discharge or other problems with her/his ears?	***Yes*** ☐	***No*** ☐

Box 3.2: Two-questions (Tonga translation of the 2-English questions in box 3.1 above)

i. ***Mwana ulabuyumuyumu na kukwambula?***	***IYI*** ☐	***PEPE*** ☐
ii. Matwi amwana akazwide busina na kana akalimukatazizye?	***IYI*** ☐	***PEPE*** ☐

3.4.2 Training village community workers

The village community workers' (VCWs) workshop was conducted to identify the "Failing" and "Following" children. Twenty-one VCWs were trained during the month of May 2001 at a 2-day workshop at Binga Centre. The VCWs were expected to acquire interviewing skills needed to enumerate all children aged 36-72 months and to identify the "Failing" and "Following" children by using the "Two-question" recruitment tool in their respective villages. The training given to VCWs was a practical oriented course.

During the session, the participants practised asking questions (interviewing techniques) before they started the identification of the "Failing" and "Following" children. The "Failing" children were those who failed either question 1 or 2 or both (see Box 3.1) i.e. the "At-Risk" children and the "Following" children were those who passed both questions in Box 3.1. Village community workers (VCWs) were equipped with interviewing and recording skills. The researcher visited 21 VCWs during data collection in their respective villages to supervise and re-assess their interviewing and recording skills.

3.4.3 Identification of the "Failing and Following" children

The "Two-questions" were used by the 21 village community workers to interview mothers or carers of children aged 36-72 months. A child who fails one or both questions has failed these "Two-questions" and is registered as a "Failing Child". The next child who passes the two-questions of the same age and sex is registered as a "Following Child". The "Two-questions" identify children with communication difficulties who are not necessarily deaf. The "Two-questions" method was adopted by this study to recruit and register subjects in the study location.

Firstly, the trained village community workers (VCWs) identified 1,048 children aged 36-72 months in their respective villages between May and August 2000. See Picture 3.2, where the team member number 2 is seen supervising one of the 21 village community workers (wearing a white woollen hat) at one of her village homes in Sikalenge ward. She is conducting a house-to-house identification of the at-risk children.

Picture 3.2: House to house identification of the at-risk children

Secondly, they used the "Two-questions" in identifying the at-risk children who were registered as "Failing". The failing children were matched age and sex with the next children who passed the "Two-questions". This second group was registered as "Following" children.

The "Two-questions" survey identified children with communication difficulties and those who had a history of ear-infections or any other ear condition but were not necessarily deaf. Eight hundred and thirty-four (834) children: 417 'failing' + 417 'following' children (n = 834) were enrolled as subjects.

Children who did not fulfil the "Failing" and "Following" criterion, including those with marked physical malformation and obvious neurological difficulties were excluded from the study.

3.4.4 Sample size calculation

The sample size was calculated by using a 2x2 sample calculation Table of the Epi-info 6.04c. A review of the literature estimated a prevalence of hearing loss of 6%-10% in children aged 36-72 months when cases of temporary conductive hearing problems are considered. This prevalence estimate was used to calculate the required sample size. Table 3.2 below shows the sample size options available for this study.

Table 3.2: Sample calculations

CI	Power	Disease Prevalence	RR	OR	Unexposed	Exposed	Total
95%	80%	6%	60	63.77	164	164	328
99%	80%	6%	60	63.77	320	320	640
95%	80%	10%	100	111	95	95	190
99%	80%	10%	100	111	185	95	370

Notes: CI = confidence Interval; RR = Relative Risk; OR = Odd Ratio.

Table 3.2 explains the confidence interval (CI) that was considered, i.e. at 95% and 99% levels with 80% power, for a sample calculation of the study. The ratio of the unexposed (U) to the exposed (E) is 1:1. The disease prevalence of hearing loss in children aged 36-72 months was estimated at 6%-10% with a Relative Risk (RR) and Odd Ratio (OR) of 60 and 63.77 respectively.

With these assumptions, the formula used came out with a sample size of 164 subjects in the unexposed group (children who passed the screen of the same age and sex were termed as following children) and 164 subjects of the exposed group (children who failed the two-questions).

A sample size of 328 children is required to test the sensitivity and specificity of the questionnaire tool at 95% CI. At 99% CI, the sample size required is 320 "Following" and 320 "Failing children". When the prevalence rate is estimated at 10%, smaller sample sizes are required at 95% CI and 99% CI, i.e. 190 and 370 "Failing" and "Following" children respectively, to evaluate a hearing screen.

3.4.5 Sample size of the study

From the sample size calculations done by use of a computer-generated formula of the Epi-Info version 6 described previously, a 6% prevalence of hearing loss was assumed based on information collected from the literature. It was then used to determine the sample size for this study. About 640 subjects were required (at 99% CI with an 80% power), i.e. 320 "Failing" + 320 "Following" children (n=640). It was decided in the field to increase the sample size to 417 "Failing" and 417 "Following" (n=834) children for dropouts. See Table 3.3 below.

Table 3.3: Children registered in the At-Risk Register (RISKR) as failing and following

Failing/Following Children	Number of Children	Percent
Failing	417	50.0%
Following	417	50.0%
Total	834	100.0%

Table 3.3 shows that this sample size allowed 30% drop out because of the volatile political situation in Zimbabwe. This was because there were on-going parliamentary elections campaigns which were very violent in the five selected wards.

3.4.6 Inclusion and exclusion criteria

Children who were identified by the two-questions as "Failing" and "Following" were recruited in the study. The rest, who did not fulfil the matching criteria and the children with marked neurological impairment, were excluded. This criterion was employed to ensure that the likely simple cases of hearing-impaired children were included in the study sample (n = 834).

During the exercise, 87 children who had been registered dropped out from the study. The data analysis further excluded those who were difficult to test (106) and non-cooperating (22) from the final sample of 747 children during the pure-tone screen. This was because the pure-tone screen was used as a referral test (gold standard test) of this study. The evaluation of the performance (the sensitivity and the specificity) of the "Questionnaire" screen was derived from data collected by the pure-tone screen compared with the "Questionnaire" screen (n=619).

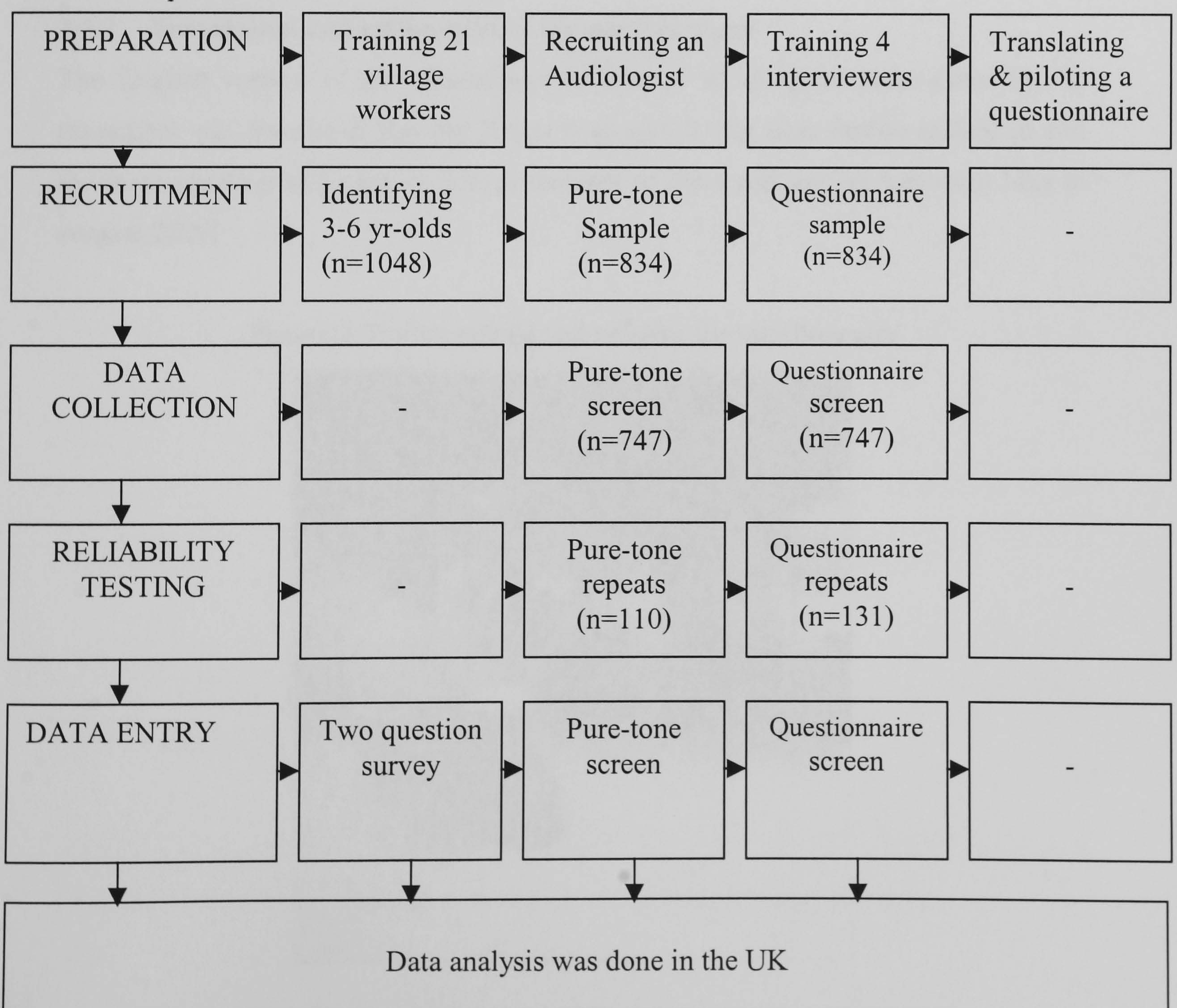
3.5 Data collection steps

Five activities were carried out in five wards from March 2000 to April 2001. The steps employed are shown in Fig 3.1, which include the following:

- preparation for the study
- recruitment of subjects
- data collection
- reliability testing
- data entry

The flow diagram below illustrates the steps implemented during "Phase 1" data collection in Zimbabwe.

Fig. 3.1: Flow Diagram of "Phase 1" data collection and activity in Zimbabwe: March 2000 – April 2001



3.5.1 Preparation of data collection

Twenty-one village community workers were trained to conduct house-to-house surveys and identified 1,048 children aged 36-72 months living in their respective villages. They recruited 834 subjects for the study (417 failing and 417 following children) by using the two-questions. After recruiting 834 subjects, four interviewers and an audiologist were engaged to collect the required data from the subjects i.e. the "Failing" and "Following" children. They conducted screening sessions with the "Failing" and "Following" children by using the following instruments:

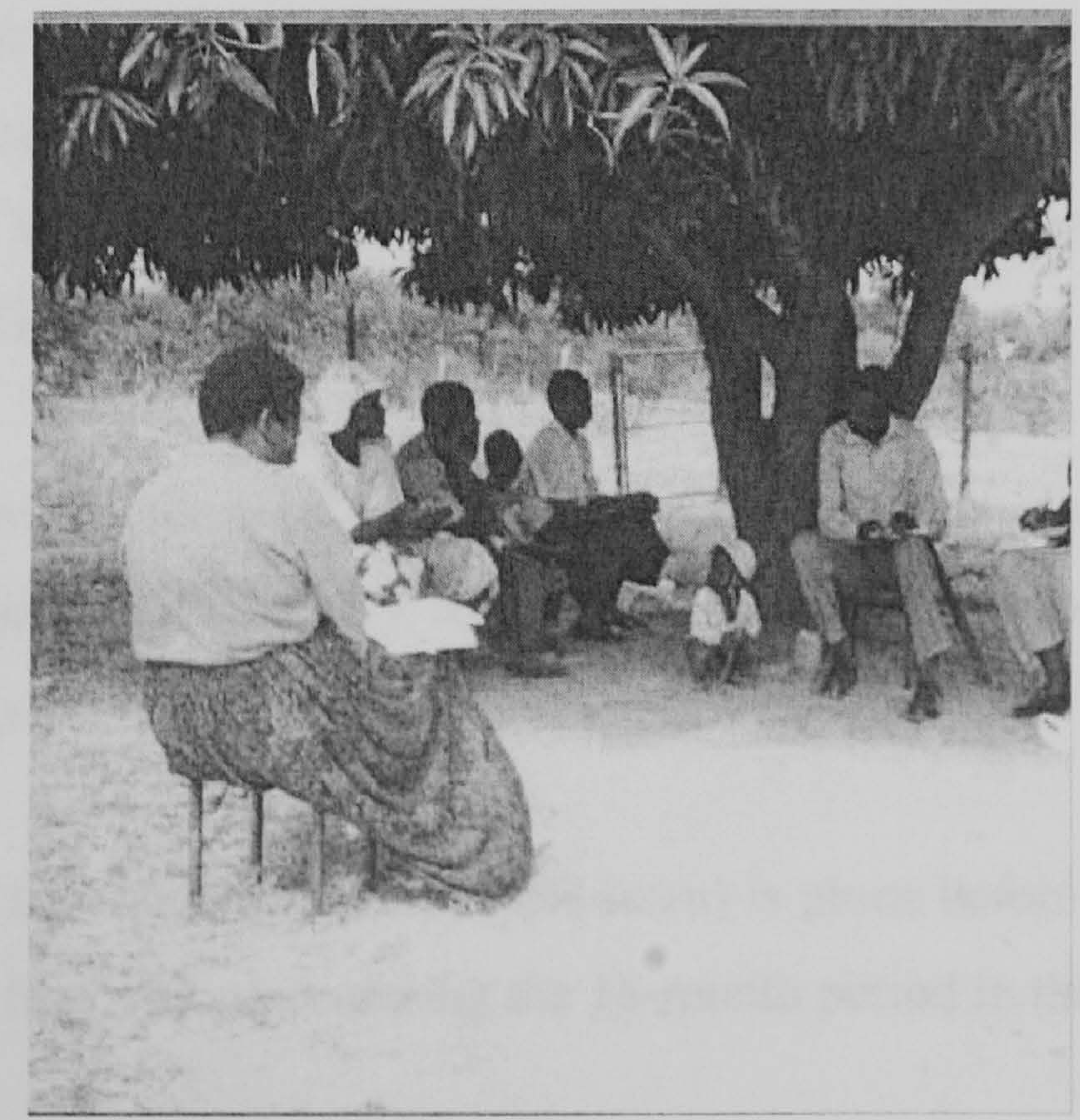
- a questionnaire tool and
- a Kamplex screening audiometer.

The questionnaire was piloted and revised before it was used to collect the required data. The process of refinement of the questionnaire is described below.

3.5.2 Translation and refinement of the questionnaire

The English version of the "Questionnaire Screen" as designed and refined by the researcher was translated into the Tonga language. It was then further refined to suit the local situation and context. The refinement of the questionnaire was from May to August 2000.

Picture 3.3: Pilot testing and refining the questionnaire



A local linguist was tasked to translate the questionnaire. The back translation of the questionnaire from Tonga to English was done by an independent person who was not involved in the initial translation of the original copy from English to Tonga. This technique was employed to compare the original English version with the back-translated Tonga to English copy.

Further refinement and back translation of the questionnaire was done up to the point when the translated Tonga copy resembled the original English version. The final translated Tonga copy was pilot-tested on the target population of the four wards, namely: Nagangala/Sinampande, Sikalenge, Muchesu and Lubu.

A few questions were modified during the pilot testing of the questionnaire. Unusual words were substituted with commonly used Tonga words in the study location. One question which required the mother or carer's observations if a child could point at a picture when she or he heard it mentioned in a quiet voice without seeing the mother or carer's lips was replaced by use of common object names, for example a dog, a cat, a cow and a goat. The interviewers were also exposed to cultural issues surrounding conducting interviews with mothers in the study location. The refinement process took four months before a final copy of the questionnaire was produced.

Several meetings with community leaders and general community members were held before data collection. The project aims and objectives were spelt out at these meetings. A consent letter for parents written by the researcher was circulated to the target group. This was done in order to fulfil the ethics requirements stipulated by the Institute of Child Health (University College London).

The letter was read to groups of parents in an introductory session before screening, because of high levels of illiteracy among the mothers of screened children. They gave consent orally.

A brief resume of the interviewers (the field team) is given before describing the data collection process that took place during the 18-month period in the field.

3.5.3 Data collection team

The six-member screening team were:

i) An audiologist, from Jairos Jiri Association (Gweru Naran School for the Deaf). He trained in Malawi in the 1970s and later trained further at Manchester University. He is the only Audiologist in Zimbabwe.

ii) Three rehabilitation technicians working for the Ministry of Health: two working at Binga Hospital and one at Victoria Falls Hospital. Rehabilitation technicians are trained and employed by the Ministry of Health and Child Welfare, Zimbabwe. Their training takes two years and skills in general rehabilitation work are emphasised both theoretically and practically. Technicians have skills in physio-and occupational therapy, speech-and language development. They also have basic skills in rehabilitating orthopaedic cases. They are multi-purpose rehabilitation cadres working at district hospitals and they are also involved in outreach programmes in the community.

iii) A remedial tutor from the Ministry of Education (Binga) is a trained teacher of the deaf and is employed to support teachers who are assigned to teach hearing impaired children in resource units and in special classes at local schools.

iv) The researcher is a PhD student at the Institute of Child Health (University College London).

v) Twenty-one village community workers were selected from the villages where the study took place. A village community worker is just literate enough to read and write and is employed part-time by the government. They are employed to work in community development programmes in their respective villages.

vi) The PhD supervisor visited and watched: i, ii, iii and iv at work.

Three rehabilitation technicians and the remedial tutor were engaged in the hearing screening exercise as interviewers. The audiologist was involved in pure-tone screening of the children using a battery powered Kamplex audiometer.

All six fieldworkers were involved in the study data collection and/or training of the project partners' staff in Binga during 2000 to 2002 (see Table 3.4).

Table 3.4: Team members' involvement (X) in various study activities: 2000 to 2002.

Team member identity number	First screen (2000/2001)		Second Screen (2000/2001)		Training (2000/2001)		Follow-up data collection (2002)
	Questionnaire	Pure-tone	Questionnaire	Pure-tone	Data collection techniques	General hearing-impairment	
1	X		X		X	X	
2	X	X	X	X	X	X	X
3		X		X	X		
4	X	X		X	X	X	
5	X				X		
6	X				X		

Notes:

Numbers 1 to 6 represent the 6-team members' identities. The notation "X" across this table shows the involvement of each team member across the major activities which were implemented during the fieldwork of this study as from 2000 to 2002.

Table 3.4 shows the field involvement of each team member during the course of this study from 2000 to 2002. The team members' involvement is notated as "X" in various study activities in Table 3.4 above. Translation of the "Questionnaire" screen and pilot testing is not included above as one of the major activities because an outsider did it, i.e. this person was not involved in this study.

3.5.4 Training four interviewers (screeners)

The four interviewers who conducted interviews with the mothers of the children brought for hearing screening were drawn from the service Ministries of Health and Education. Before being engaged as interviewers on this study, they were trained for a week in June 2000 in interviewing techniques and other requirements. Practical oriented skills such as interviewing techniques were emphasised during the training sessions.

Further practical field sessions were conducted during the pilot testing of the translated questionnaire. The questionnaire screen was translated into the local language, Tonga, before use.

3.6 Data collection procedures

The data collection period was divided into two:

- The first procedure was to interview mothers or carers of the "Failing" and "Following" children with the questionnaire screen of the study sample i.e. the "Failing" and "Following" children matched age and sex (n=834).
- The second procedure was to conduct a pure-tone screen of the study sample i.e. the "Failing" and "Following" children matched age and sex (n=834).

The data collection activities mentioned above are described below.

3.6.1 Screening children

Interviews and pure-tone screening sessions to identify deaf children were conducted as from June to September 2000. This period coincided partly with the school holiday for the following reasons:

i) Firstly, the school children were at home on holiday. This was a way of minimising surrounding noise as there was less ambient noise generated by children around the school that have would have made pure-tone audiometric screening difficult to carry out.

ii) Secondly, the classrooms were not in use during school holidays and this gave the screening exercise the required workspace.

iii) Finally, the exercise did not disturb normal school activities since the screening exercise used local resources like benches; classrooms, chairs, desks and tables which were community contributions provided by schools or clinics.

3.6.2 Screening schedule

The screening exercise was structured and some standard guidance on how to allocate a waiting place for mothers or carers and their children was offered. The set-up of screening stations, such as the distance between stations (a two-classroom space in between), were detailed in the guidelines to reduce ambient noise for the allocated pure-tone station. The researcher made sure the guidelines were adhered to as far as possible.

The data collection (screening children) was done as per the schedule outlined in Table 3.5.

Table 3.5: The questionnaire and pure-tone screen schedule

VENUE	WARD	DATE
Muchesu Clinic	Muchesu	10 – 13/08/00
Lubu Primary School.	Lubu	14 – 18/08/00
Manjolo Spring Primary School	Sikalenge	20 – 21/08/00
Manjolo Secondary School	Sikalenge	22 – 23/08/00
Samende Primary School	Sikalenge	24 – 25/08/00
Musenampongo Primary School	Sikalenge	26 – 27/08/00
Nagangala Primary School	Nagangala/Sinampande	28 – 30/08/00
Sinampande Primary School	Nagangala/Sinampande	31/08 – 01/09/00
Musenampongo Primary School	Sikalenge	02/09/00
Sianzyundu Clinic	Sianzyundu	04 – 05/09/00
Zambezi Primary School	Sianzyundu	06 – 07/09/00
Junamina Primary School	Sianzyundu	08 – 09/09/00
Masumu, Crocodile Farm	Sikalenge	10/09/00
Binga District Hospital	Sikalenge	11 – 13/09/00
Muchesu Clinic and Lubu Primary School	Muchesu and Lubu	19/09/00
Nagangala and Sinampande Primary Schools	Nagangala/Sinampande	20/09/00
Manjolo Spring Primary School	Sikalenge	21/09/00
Sianzyundu, Zambezi and Junamina Schools	Sianzyundu	06 – 21/11/00

There were 747 children who were screened during the period covered by the above schedule in Table 3.5. The procedure followed is described in the next subsection.

3.6.3 Screening procedure

The screening procedure was organised in 3 segments or stations as follows:

i) Station 1: An entry point, where all clerical work was done, i.e. monitoring the failing/following register, vetting the incoming child's eligibility for a screening and allocating an identity number (ID No). The clerk then directed the child and her/his mother or carer to station 2.

ii) Station 2: The questionnaire screening point, where the screener receives the child and his/her mother or carer. The screener asks the mother or carer the set of questions on the questionnaire and performs some auditory acuity detection tasks with the child. They then record all the responses and their observations and summarise the outcome of the screen on the top copy of the questionnaire. The child and their parent or carer is sent to station 3 where the audiologist performs a pure-tone audiometric screening.

iii) Station 3: the child goes into a room with a battery-powered audiometer, which has recently been calibrated. The audiologist performs the pure-tone audiometric screening without any background information on how the child performed on the questionnaire screen. Four frequencies are selected and used throughout the screening exercise viz.: 0.5 kHz, 1 kHz, 2 kHz and 4 kHz. Initially as far as possible, it was planned to obtain the lowest hearing threshold from each screened child, but the ambient noise made it impossible to read the 30dBHL screen. It was then set at 50dBHL for all the children.

After the day's work, one person collected questionnaires from stations 2 and 3, usually the person positioned at station 1. The questionnaires and audiograms were filed immediately in separate files and were kept by the person manning station 1 (usually by the researcher or the other person appointed by him to work on station 1 during his absence). There was tight security around the files and no one except the station 1 clerk had access to the questionnaires and the audiograms from stations 2 and 3.

Before the team retired to bed they met to discuss and record the general observations noted during the day, such as:

i) The attendance of children at the screen.
ii) Recording important events in the community.
iii) Recording the weather pattern of the day.
iv) Discussing the general public health status of the community members especially children, e.g. food security, nutritional activities (e.g. gardening for personal food growing and rain fed crops grown by the community for cash and subsistence).
v) Recording the referrals done by the hearing screening team to other institutions, such as the clinic, hospital and local school.
vi) Also, recording children above and under the target group (36 – 72 month olds) screened by the team during the day.

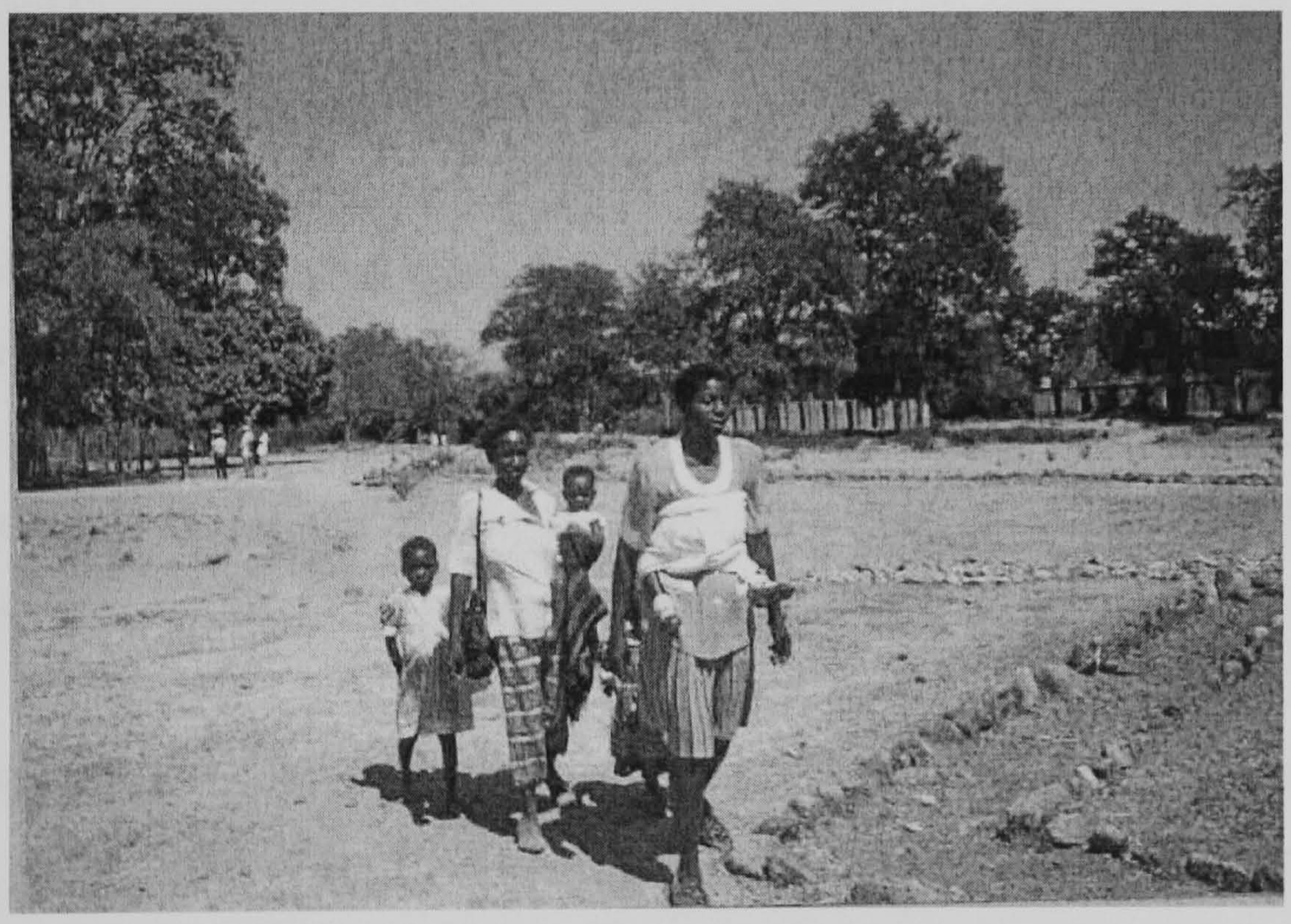
A field diary was maintained, which recorded observations at each screening and provided this study with a record of summarised events and general community observations.

3.6.4 "Questionnaire" screen interviews

Seven hundred and forty-seven (747) "Failing" and Following" children recruited in the study were screened by use of the "Questionnaire" screen that was directed to mothers or carers of children attending the screen. This was a high compliance rate of 0.90. The 87 children who were not screened dropped from the study for various reasons, amongst which were: away for holidays, illness and mothers or carers unable to attend for reasons such as being busy with household chores or too old to walk to the screening venues.

Village community workers visited house-to-house reminding mothers or carers to attend hearing screening interview sessions on specified dates. See Picture 3.4 some of the 747 children brought by their mothers or carers for screening.

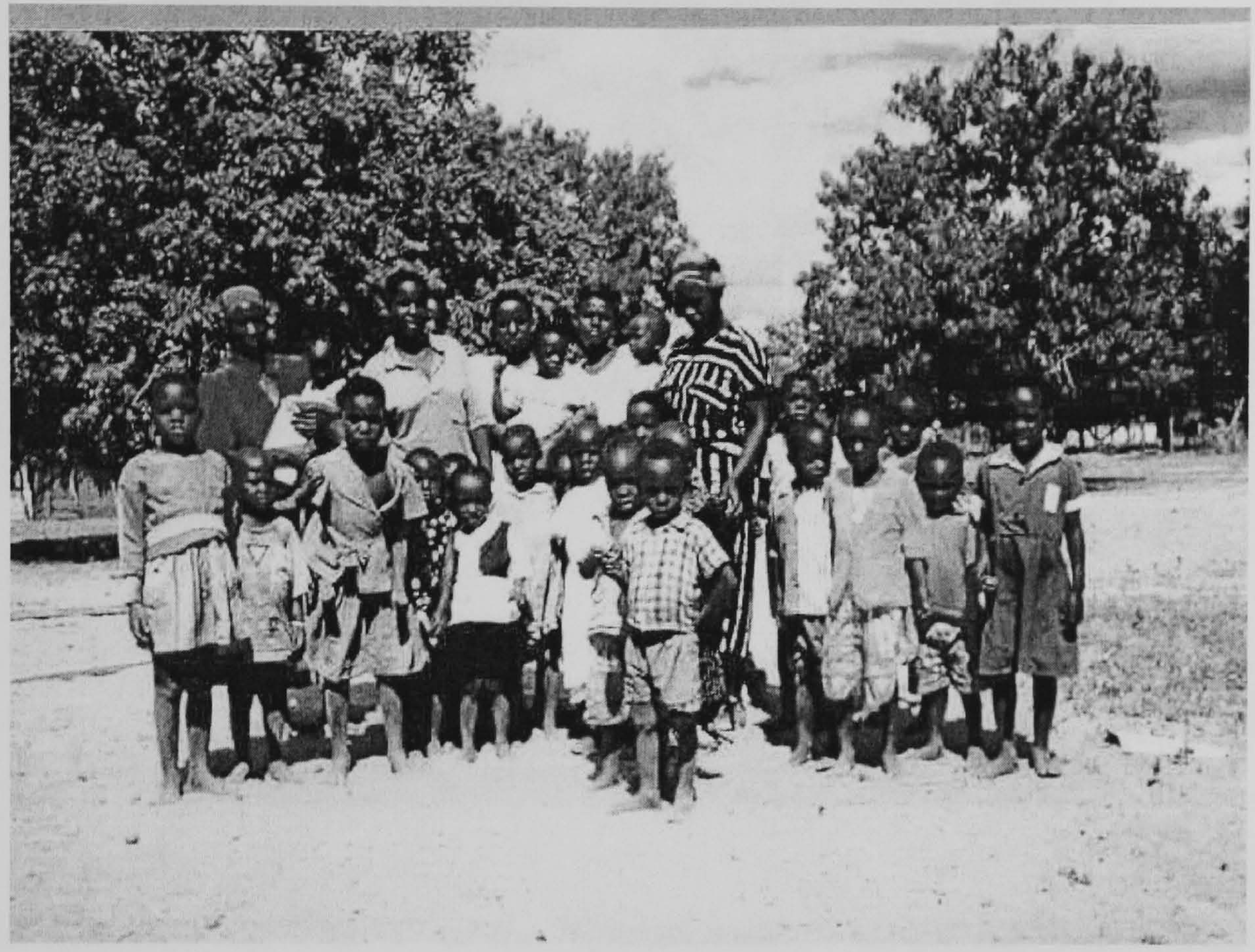
Picture 3.4: Mothers bringing their children for screening



On the due date, mothers or carers brought their children to a screening venue. The screening venues were at selected schools or clinics. At a screening venue, the screening team of 4 people stood ready for mothers or carers to arrive as early as 07.30 hours. As the child and their mother or carer arrived at the venue, they were received by the study administrator/receptionist, who made sure they were both settled. They explained the purpose of the screen and what the mother or carer's participation was going to contribute to the overall aim of the study.

See some children waiting for their turn for screening in Picture 3.5.

Picture 3.5: Children waiting for a screen with pre-school teachers



The consent of the mother or carer to participate in the study was verbally requested. After making the mother or carer settled she or he was given the "Questionnaire" marked with the allocated identity number on which was written the child's name. The mother or carer and child were directed to the other room or shady place where an interview was conducted by a Tonga language fluent interviewer.

The interviewer received the mother and child. They made them comfortable and explained in brief how they would conduct the interview. The mother or carer was told the time the interview would last. Then the interviewer requested the mother or carer to hand-in the questionnaire given to her at the reception. The mother or carer's permission to proceed with answering some questions was requested and granted.

The interview session proceeded by going through questions on Part 1 of the "Questionnaire" screen (for every child), which collected some demographic data about the child (see Picture 3.6, one of the field workers interviewing the mother or carer).

Picture 3.6: Interviewing the mother

After the questions on "Part 1" of the "Questionnaire" screen had been asked and the answers recorded, the interviewer selected an age specific section from "Part 2" of the "Questionnaire" screen. They then asked the mother or carer the questions in this section. Some of the questions required playing a game of naming body parts with the child. The child was expected to imitate or point to the part of their body mentioned in a quiet voice by the mother or carer and the interviewer. The responses given by the mother or carer and the child were recorded on the "Questionnaire" screen.

The interview session ended with the interviewer thanking the mother or carer and his or her child for participating in the session and it was explained to the mother or carer that she or he was expected to attend the next session in another room where the child's hearing was to be evaluated by use of a machine (audiometer) by an audiologist.

The mother or carer and child were then directed to the pure-tone screening room.

3.6.5 Pure-tone screening

The audiologist pure-tone screened 747 of the same children who were previously screened by the "Questionnaire" screen. For the screening session, the audiologist received the mother or carer and child referred from an interview-room. The pure-tone screening room was situated in a quiet place far from the other two stations, i.e. the reception and the interview rooms or area.

The audiologist made sure the mother or carer and child were settled. Because the audiologist spoke very little Tonga, a village community worker was always present for interpretation between him and the mother or carer and child. He conditioned the child before the actual testing took place.

The child was exposed to the testing procedures such as putting on the headphones, listening to sounds produced by the audiometer, and throwing pebbles in a plastic bucket each time the child heard a sound through the headphones. After the audiologist had satisfied himself that the child was ready for testing, he commenced the screening as demonstrated.

The child wore headphones during the tests. Four test frequencies (0.5k, 1k, 2k and 4k) were selected. The cut-off threshold level was set at 50dBHL. The child was required to pick a stone and throw it into the plastic bucket each time s/he heard a sound generated by the audiometer through the headphones.

Three stimuli were presented at each of the four selected frequencies in each ear. The child was expected to identify 2 or 3 times the sound stimulus to have passed the screen at 50dBHL. The results were plotted on the audiogram.

The testing session ended with the audiologist thanking the mother or carer and child for attending the session and they were asked to come again if they were invited for the repeat screening. See the audiologist conducting a screening session in Picture 3.7.

Picture 3.7: The audiologist performing pure-tone screen

Children who failed the pure-tone screening were referred to a doctor at Binga Hospital. The mother or carer was assured that the referral was done to make sure a medical practitioner further assessed the child's hearing and gave professional advice on the child's hearing status. The 117 children who were referred for medical intervention were followed-up. All referrals were treated for otitis media and 10 children were further recommended for school placement assessments.

3.6.6 Reliability testing

For the questionnaire inter-or intra-user reliability testing, 131 (n = 131) children were randomly selected and re-interviewed. During the second interview sessions, the procedure described above for questionnaire interviews was repeated. The data collected was compared with the interviewers' first and second results for consistency (agreements and disagreements). For the repeat pure-tone screening, 110 children were randomly selected and the same procedure described for the pure-tone screening sessions was adopted. The repeat pure-tone screening was conducted to validate the consistency (the variability) of the audiologist test results. The reliability testing was done to confirm the consistency of the screening results. The study instruments used by the screening team are now described in detail.

3.7 Study instruments

This section describes the questionnaire tool that was translated from English to Tonga, piloted and refined in Binga, Zimbabwe before it was used by this study. The referral pure-tone screening instrument used was a Kamplex audiometer, which is also briefly described in this section.

3.7.1 "Questionnaire" screen

The questionnaire designed by Dube's (1995) study was revised and used in collecting data for this study.

The questionnaire is divided into two Parts:

a) "Part 1"; General information for each child, collects the bio-data such as: name of child, date of birth, address, birth weight, mother or carer's worries concerning child not able to hear and history of deafness in the family.

b) "Part 2" Age specific (10-questions plus observations scale);
   1. Section 'A' 36-48 months
   2. Section 'B' 49-60 months
   3. Section 'C' 61-72 months

Each section has 10-questions asking the mother or carer about her observations regarding her child's hearing, e.g.:

- Can s/he point to at least one part of her/his body, when you ask her/him in a quiet voice?
- Does s/he watch the speaker's face and mouth?

In addition to the 18 questions for each age group the interviewer records observations for the full version of the questionnaire (see the "Questionnaire" screen Appendix I and II).

Observations (OB) Scale: the interviewer is requested to place a cross (X) on the scale provided, indicating her or his observations about the child's hearing responses to the interviewer and mother or carer's instructions. The scale used is presented in Fig. 3.2.

Fig. 3.2: Observations scale to plot the child's hearing responses

Never										*Always*
0	1	2	3	4	5	6	7	8	9	10

A tick in a **Yes or No** box as shown in Box 3.3 below indicated the interviewer had determined if a child had passed or failed the screen.

Box 3.3: Evaluation of hearing loss: the interviewer's summary.

Indication of hearing loss:	**Yes [ ]**	**No [ ]**

The questionnaire results are summarised by the statement in Box 3.3 to which the response is either yes or no. The evaluation does not diagnose hearing impairment but can only suspect hearing loss in the child screened. The children who were interviewed by use of this questionnaire were also subjected to pure-tone screening sessions where a screening audiometer was used.

A Kamplex screening audiometer is briefly described below.

3.7.2 Kamplex screening audiometer

The Kamplex screening audiometer (calibrated, which expires early 2002) was used for pure-tone screening hearing loss in children aged 36-72 months. Pure-tone audiometry could be a diagnostic or screening protocol. It uses calibrated equipment that produces pure-tones.

This study used air conduction by using earphones positioned on both ears. Four frequencies, 0.5 k, 1k, 2k and 4k, were used. Initially, an attempt was made to measure the threshold level at which an individual child listened through standard earphones to hear different frequencies. That was impossible because children, especially the 3-year-olds, displayed a short listening span. Compounded by the ambient noise, it was practically impossible to evaluate hearing threshold above 40dBHL even though it is still a significant important measure. The protocol was then revised and set at 50dBHL.

This pure-tone screening protocol was used as a gold standard to compare the results of the questionnaire against pure-tones.

3.7.3 Suitability of the study instruments

Reliability is critical for evaluating the suitability of a test to accurately measure the characteristic or ability of interest. Reliability is an important concern for the user of any test because it gives an indication of the accuracy of the test. Higher levels of reliability indicate less error variance and consequently high correspondence between the observed score and the individual's true score (true positives and true negatives in the case of a hearing screen as opposed to false positives and false negatives).

Internal consistency reliability assesses the degree to which items on the test are constant in the measurement of the underlying construct. Operationally, this reliability is examined by the intercorrelations among the item test (Kirkwood, 1994).

Interviewing mothers and carers of children aged 36-72 months was an appropriate procedure adopted by this study. In theory the 3 year-olds are developmentally ready for the pure-tone testing that is used as the gold standard. Secondly, there are pre-schools established in the rural areas in Binga for 3-6 year-olds.

The advantages of the interview method are:

i. It is interactive and an adaptable way of finding out about a child's hearing.
ii. The face-to-face relationship offers the possibility of clarifying some unclear Tonga dialects, following up interesting responses and investigating underlying motives in a way that postal and other self-administered questionnaires could not.

iii. Non-verbal cues give messages, which help in understanding the verbal responses, which could possibly change or even, in extreme cases, reverse their meaning.

iv. It can be used by non-specialists and is cheap.

However, this method has few disadvantages:

i. Profitable use of this interactive approach calls for considerable skill and experience in the interviewer. This was made more likely by training and supervising the data collectors (fieldworkers).

ii. The standardisation of the questionnaire implies that it inevitably reduces concerns about inter-and intra-user variability. But biases are difficult to rule out.

iii. Interviewing is time-consuming. The interview sessions obviously varied in length of time. Anything under half an hour is unlikely to be valuable; anything going much over an hour makes unreasonable demands on busy interviewees, and could have the effect of reducing the number of persons willing to participate, which may in turn lead to bias in the sample achieved.

The questionnaire used in this study demands a highly structured interview, with a predetermined set of questions. The responses are recorded on a standardised schedule. This is a deliberate design because it is expected that the questionnaire might be a screening protocol. It would need to be tested and standardised later if found reliable in detecting permanent hearing loss in children.

3.8 Statistical treatment

The information collected from the field was analysed to compare the performance of the "Questionnaire" screen against the pure-tone screen using an analysis model adapted from Jacobson and Jacobson (1987). The results of the comparison of the two screens are presented in chapter 4 where computation of the sensitivity and specificity of the "Questionnaire" screen is done from data stored in the EPI-INFO 6.04c computer software. This analysis model assisted in computing the sensitivity and specificity of the "Questionnaire" screen.

3.8.1 Chi-square statistical analysis

Another type of analysis done was a non-parametric statistical test, the Chi-square (X^2), to test the significance of each question contained in the "Questionnaire" screen. The level of performance of the "Questionnaire" screen has been fully explained and some non-obvious tendencies described in context. The performance variables of the questionnaire are commented upon in chapters 4 and 5 of this thesis.

3.8.2 Decision matrix analysis

The "Questionnaire" screen was evaluated in identifying bilateral permanent hearing loss in excess of 50dBHL of the better ear compared with the pure-tone screen by using a decision matrix analysis model adapted from Jacobson and Jacobson (1987). This model determines the actual level of the performance of the new screen compared with conventional protocols such as the pure-tone screen.

The notations used in the formulae of this model are explained as notes of Table 3.6 below.

Table 3.6: Matrix analysis for test performance characteristics[a] of the "Questionnaire" screen

Questionnaire screen	**Pure-tone screen**		**Total**
	Pass	**Fail**[b]	
Pass	TN	FN	**TN + FN**
Fail	FP	TP	**FP + TP**
Totals	**TN + FP**	**FN + TP**	**TN + FN + FP + TP**

Notes:

[a]*Adapted from Jacobson and Jacobson (1987)*

[b]*TP, true positive; TN, true negative; FN, false negative; FP, false positive*

The interpretation of the model illustrated in Table 3.6 above is as follows:

- Sensitivity: TP/FN+TP
- Specificity: TN/TN+FP
- Predictive value of positive test: TP/FP+TP
- Predictive value of negative test: TN/TN+FN
- Overall: TN+TP/TN+FN+FP+TP
- Incidence: FN+TP/ TN+FN+FP+TP

The formulae provided by this model were used to determine the sensitivity, specificity, predictive value of positive test, predictive value of negative test and the overall performance of the "Questionnaire" screen.

The data analysis excluded those who were difficult to test (106) and non-cooperating (22) from 747 children by the pure-tone screen. This was because this screening protocol was used as the gold standard screen of this study. There were 619 valid cases used in determining the performance of the "Questionnaire" screen compared with the pure-tone screen (n=619).

3.9 Limiting conditions

In this section, some factors are examined that might introduce bias in the study results. Such factors included environmental conditions and variable restrictions. The study design shortfalls and instrument measurement errors are all described.

3.9.1 Environmental conditions

There were various environmental conditions, which prevailed in Binga district and in Zimbabwe during data collection. It is expected that these conditions would have an impact on this study and might have influenced the outcome of the results.

These factors are described below as follows:

i. This study was carried out in Binga, Zimbabwe with minor cultural and economic variations from one ward to another. It is usually believed that a rural community such as the study location is fairly homogenous despite some local variations.

ii. The political situation in Binga was very volatile at the time of data collection and might have influenced some informants to withdraw from the study. It is difficult to ascertain the influence of this factor on the outcomes.

iii. Recall bias: the mothers or carers were asked to remember events which they observed during child rearing as far back as 72 months ago. Chances of memory and recall bias are possible. Recall, i.e. remembering past events, is a major retrospective study problem.

iv. The study was planned to collect follow-up data in Binga 12 months later to assess the impact of the training intervention between the trained and untrained workshop participants. Data collected after such a long time cannot measure the difference of KSAP between the trained and untrained subjects because colleagues share information about work.

v. This study should be taken as a baseline to test the sensitivity/specificity in the identification of permanent hearing loss in children. Further investigation on the refinement of the tool is required to improve its performance in identifying moderate cases of permanent hearing impairment and appropriate services for deaf children in rural Zimbabwe.

Due to those reasons mentioned it is believed that an unavoidable occurrence of this nature would have introduced a bias in the study. The bias might have a confounding effect on the final outcomes of the study.

3.9.2 Variable restrictions

Wirz, Hartley et al's (2001) study in Brazil revised the original "Questionnaire" screen (Dube, 1995) intensively. Wirz, Hartley et al's (2001) study instrument was further revised by the researcher for this study.

Although this "Questionnaire" screen was intensively piloted and refined in the field, mothers or carers could still misunderstand certain questions of the screen because Binga district has varied cultural and dialect differences. The responses from those mothers or carers who spoke dialects could be confusing because these interviews were conducted in a standardised Tonga language. The variables generated by the study tool (the "Questionnaire" screen) should be described and interpreted in a wider cultural context. This aspect limits the generalisation of the outcomes of this study.

Further variable restrictions of this study were encountered with the difficult to test (106) and non-cooperating (22) children by the pure-tone screen. While the "Questionnaire" screen did not encounter difficult to test and non-cooperating children the pure-tone screen (the gold standard test) had a total of 128 difficult cases, which were excluded in the computing of the sensitivity and the specificity of the "Questionnaire" screen. Data collected from 128 cases were excluded from the formulae provided by the model illustrated in Table 3.6, which were used to determine the sensitivity, specificity, predictive value of positive test, predictive value of negative test and the overall performance of the "Questionnaire" screen because the pure-tone screen was the gold standard test of this study. There were 619 valid cases used in determining the performance of the "Questionnaire" screen compared with the pure-tone screen (n = 619).

3.10 Summary of "Part A" methods

"Part A" methods of this study were used to evaluate the "Questionnaire" screen in identifying children with permanent hearing impairment compared with the pure-tone screen taking into consideration the problems of sample selection of conditions with low prevalence for either service delivery or research programmes, in sparsely populated rural areas. Sample selection is time consuming and expensive.

In view of the problems of sample selection of this study a recruitment methodology was designed which used the "Two-question" recruitment tool to identify children at risk of permanent hearing loss in Binga District, Zimbabwe. The recruitment tool identified 1048 Tonga children aged 36 - 72 months of whom 417 had either difficulties in speaking or ear diseases or both difficulties in speaking and ear diseases but not necessarily deaf. This group was labelled as the "At-risk" cohort which was then matched age and sex to form a control cohort (n=834). During the data collection period 747 (90%) from 834 children were screened by use of the "Questionnaire" screen and the pure-tone screen and the results of these screens were compared. Out of the 87 (10%) children who dropped out of the study 10 were the "Failing" and 77 were the "Following" children (n=834).

Only a child identified as at-risk by the two-question recruitment tool plus the next one who passed the recruitment tool matched age and sex was included in the study. Children identified as not at-risk and who did not fulfil the matching criteria and those with marked neurological impairment were excluded. The criterion of recruiting the high-risk and non-risk group were employed to ensure that deaf children were included in the sample. A random sampling method was rejected. This was because of the low prevalence of permanent hearing loss in children which is estimated at 3 per 1,000 live births per year (Maxon et al, 1997).

However, when cases of temporary conductive hearing loss are included about 6-16% of children aged 36 – 72 months are estimated to have fluctuating hearing problems in Zimbabwe (McPherson B and Swart, 1997).

The test instrument employed in this study was a revised version of Dube's (1995) study "Questionnaire" screen which was compared with the pure-tone screening results obtained from the use of a portable Kamplex screening audiometer. This "Questionnaire" screen consists of two parts; "Part 1" has 8 general questions for every child, while "Part 2" has three age specific sections (A, B and C) with a set of 10 questions in each section i.e. each child is asked 18 questions in all.

The mother or a carer brought each child to a screening area. Four local interviewers, fluent in the Tonga language, screened children by interviewing mothers or carers of children brought for hearing screening. All interviews were conducted in Tonga. The interview administration required 25 - 30 minutes for each child. After the interviews, the child was given the pure-tone screening conducted by the qualified and experienced audiologist used as the gold standard for comparison. The child being screened was brought into a room where the pure-tone screening was conducted. The pure-tone screening required the child to wear headphones and they were instructed to respond to test stimuli by dropping a stone in a plastic bucket each time they heard a sound generated by the Kamplex screening audiometer.

The test frequencies used were 0.5k, 1k, 2k and 4k. The test sound level was set at a cut-off point of 50dBHL. These four frequencies were chosen because they represent low, medium and high frequencies across the speech spectrum. Left and right ears were tested separately. The pure-tone administration required 10-15 minutes for each child. A pass or fail result was plotted across the four test frequencies on the audiogram. A total of 747 (90%) from 834 children were screened by use of the "Questionnaire" screen and the Kamplex screening audiometer (n = 834). There were 87 (10%) children who dropped from the study. For reliability testing, two sample groups of 131 (18%) and 110 (15%) children randomly selected from the sample population of 747 children were screened to validate the questionnaire and pure-tone audiometric screening results respectively (n = 747).

During data entry into the EPI-INFO version 6.4c database, pass results of the pure-tone audiometric screen of each child's hearing threshold were coded as: Pass = 50; difficult to test = 55; Fail = 60 and non-cooperating = 65. During data analysis children who were difficult to test (coded 55) and non-cooperating (coded 65) were excluded in the computation of the sensitivity and specificity of the "Questionnaire" screen because the pure-tone screen was taken as the referral test (gold standard) of this study.

The "Questionnaire" screen was evaluated in identifying bilateral permanent hearing loss in excess of 50dBHL of the better ear compared with the pure-tone screen by using a decision matrix analysis model adapted from Jacobson and Jacobson (1987). The formulae provided by this model were used to determine the sensitivity, specificity, and predictive value of positive test, predictive value of negative test and the overall performance of the "Questionnaire" screen (see Table 4.5). A 2 x 2 table analysis for sensitivity, specificity, predictive value and test bias was also used to test all the items contained in the "Questionnaire" screen against the pure-tone screen.

The methods described below in "Part B" of this chapter were employed twelve months later, which collected data for the follow-up assessment of this study to evaluate the impact of training project partners in Binga district.

Part B

3.11 Methods employed to collect follow-up data of this study

This study provided appropriate services to fulfil an ethical issue of screening hearing loss in children and complement efforts existing within the means available for programmes of the deaf in Binga district. "Part B" describes methods employed during the follow-up data collection of this study assessing the impact of the intervention component.

Purpose

The aim of the assessment was to explore strategies of inclusion of hearing-impaired children in the mainstream activities in rural Zimbabwe. The objective was to assess the knowledge, skills, attitudes and practices (KSAP) of participants trained by the hearing screening programme in the five selected wards.

The research question answered by the field data was whether training on screening hearing loss changes service providers' attitudes and practice in the field?

It was hypothesised that non-audiology specialised workers can be trained and reliably use the "Questionnaire" screen in identifying bilateral permanent hearing loss in children and the knowledge and skills on screening and rehabilitation of deaf children of the course participants can translate into action by enrolling deaf children at ordinary pre-and primary schools and improves service delivery in Binga district, Zimbabwe.

Training intervention

The activities implemented during 2000 to 2001 were as follows:

a) Five awareness meetings were held for councillors and chiefs in Binga district
b) Twenty-one village community workers (VCWs) were trained on screening hearing loss in children by using the "Two-question" recruitment tool
c) Six Binga and Victoria Falls hospital health workers were trained on screening hearing loss in children by using the "Questionnaire" screen

d) Twelve school heads and one specialist teacher of the deaf were trained on screening hearing loss and the integration of hearing impaired children at local schools

e) Forty pre-school teachers from the study wards were trained on screening hearing loss and integration of hearing impaired children at local pre-schools

f) Ten deaf children were assessed for school placement at local schools

g) One hundred and ten children (n=110) who failed the pure-tone screen were enrolled in a surveillance register

h) The surveillance register was handed over to the Ministries of Health and Education at Binga offices

i) The follow up study to assess the knowledge, skills, attitudes and practices (KSAP) of the trained teachers, health workers and non-governmental organisation workers in the study location was conducted twelve-months later in 2002.

3.11.1 Preparation for the training intervention

During "Phase 2" of the study, training programmes were implemented on the identification and rehabilitation of deaf children in Binga, Zimbabwe. Workshops were conducted for the collaborative group staff working in the study wards as follows:

- Five-day workshop for 10 "Questionnaire" screen interviewers
- One-day workshop for 21 village community workers (n=21) from 21 villages of the study wards on identifying the at-risk children.
- One-day workshop for 10 health workers, 11 school heads and 4 social workers (n=25) from the study wards on screening hearing loss and rehabilitation of hearing-impaired children in normal classes.
- Two-day workshop for 40 pre-school teachers (n=40) from 5 study wards on screening hearing loss and rehabilitation of hearing-impaired children at normal pre-school.

A total of 86 course participants (n=86) drawn from 5 study wards were trained for the purpose of providing relevant information and imparting relevant skills on the identification and rehabilitation of deaf children in the community.

A qualitative assessment to evaluate the impact of the training sessions of this study was carried out. Data were collected on randomly selected focus group and questionnaire subjects (n=86). Data were collected between May and June 2002, by the fieldworker 2 who was supervised by the author. Data were collected from the focus group interviews with pre-and primary school teachers, community village workers, rehabilitation technicians and other development workers who were trained and those not previously involved in this study. Self-administered questionnaires were sent to trained and non-involved subjects.

Children who failed the pure-tone and "Questionnaire" screens were followed to establish numbers attending local pre-and primary schools. Focus group discussions were transcribed, coded and analysed. The follow-up data collected by the questionnaire were entered into Epi-Info 2000 and analysed later.

See Fig. 3.3 of the flow diagram illustrating steps followed during phase 2 data collection period between May 2001 and June 2002 in Zimbabwe.

The next subsection describes chronologically the steps illustrated in Fig 3.3 of data collection of the follow-up assessment of knowledge, skills, attitudes and practice (KSAP) of the teachers, community workers and health workers who attended training workshops' which were organised by the author during the 2000 to 2001 data collection period of this study.

3.11.2 Follow-up data collection steps

The follow-up data was collected between May and June 2002 in 5 study wards. The steps followed are illustrated in a flow diagram presented below (see Fig 3.3).

Fig. 3.3: Flow diagram of follow-up data collection and activity in Zimbabwe: May 2001 – June 2002

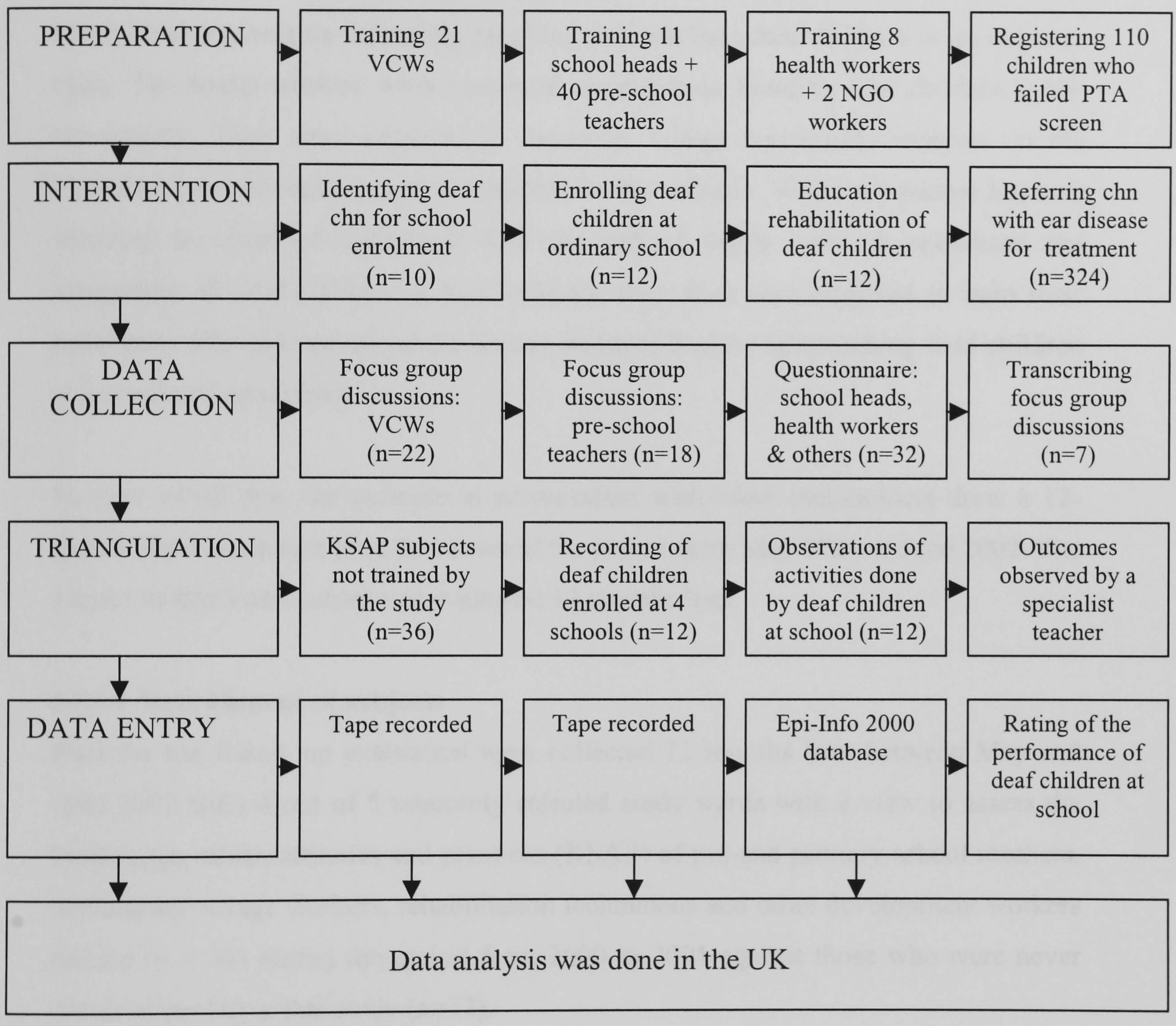


Fig. 3.3: shows the steps of the training intervention and follow-up data collection for this study that was conducted 12 months later in Zimbabwe. These steps included the following tasks: preparation of the intervention, intervention, and data collection, triangulation and data entry and analysis. All five steps listed above were done in Zimbabwe with the exception of the data analysis that was done in the UK. The details of these steps are described in the subsequent sections.

3.11.3 Training intervention

The training programme was aimed at increasing capacity of the service component of this study to be implemented by the Ministries of Health and Education who were the collaborative group of the study.

The service ministries mentioned above were to use headmasters to re-train other lower level teachers on screening, enrolling and teaching deaf children in an ordinary class. The health workers were sensitised on problems faced by deaf children in the community. They were expected to supervise village community workers on the identification of hearing impaired children in the villages. While pre-school teachers working in close co-ordination with the school heads were to spearhead the integration of deaf children at local schools, they were also expected to train their colleagues who did not attend the course on identification and teaching deaf children at an ordinary pre-school.

In view of all this, the partners in consultation with other stakeholders drew a 12-month implementation plan that covered the period from May 2001 to June 2002. The impact of this intervention was evaluated 12 months later.

3.11.4 Recruitment of subjects

Data for the follow up evaluation were collected 12 months later between May and June 2002 from 4 out of 5 randomly selected study wards with a view to assess the knowledge, skills, attitudes and practices (KSAP) of pre-and primary school teachers, community village workers, rehabilitation technicians and other development workers trained (n = 36) during the period from 2000 to 2001 against those who were never involved (n=36) in this study (n=72).

Children from two randomly selected study wards who failed the pure-tone screen during the 2000 to 2001 data collection were also followed up in 2002 to ascertain their inclusion at local pre-and primary schools in their community.

See Table 3.7 on the sample framework of the follow-up data collection of this study implemented 12 months later.

Table 3.7: Sample framework of the follow-up of the study assessing KSAP of course participants trained at 3 workshops from 5 study wards numbered 1, 4, 5, 17 and 21, see Table 3.1 for wards (n=86)

Occupation	Trained
Pre-school teachers	40
Village community workers	21
School heads	11
Health workers	10
Social workers	4
Total	86

The 86 people who participated at these training workshops were expected to carry out intervention activities such as; to identify deaf children, enrol deaf children at local schools for education rehabilitation and refer those with ear diseases for medical treatment or further investigations at local clinics or Binga Hospital.

3.11.5 Post twelve months follow-up data collection

A random selection of 36 subjects from the group trained matched by their occupation and community of residence of 36 controls were recruited into the study, see Table 3.8 below. This criteria was employed to ensure basic understanding and experience of the community work

Table 3.8: Sample size of Phase 2 of the study of subjects trained at 3 workshops and untrained recruited from 4 selected wards numbered 4, 5, 17 and 21 see Table 3.1 for wards (n=72)

Occupation	Trained	Untrained	Total
Pre-school teachers	9	9	18
Village community workers	11	11	22
School heads	11	11	22
Health workers	3	3	6
Social workers	2	2	4
Total	36	36	72

Table 3.8 shows that a total number of 72 subjects were recruited for this study as follows:

- 22 school heads (n = 11 trained + 11 untrained),

- 6 health workers and 4 social workers were given a questionnaire (n = 5 trained + 5 untrained).
- 18 pre-school teachers and 22-village community workers were invited to participate at 7 focus group discussions conducted by two trained interviewers (n = 20 trained + 20 untrained).

See Table 3.9 below for the sample distribution between self-administered questionnaire and focus group discussion.

Table 3.9: Sample distributions between self-administered questionnaire and the focus group discussion (n=72)

Occupation	Questionnaire (n=32)		Focus group discussion (n=40)	
	Trained	Untrained	Trained	Untrained
Pre-school teachers	-	-	9	9
Village community workers	-	-	11	11
School heads	11	11	-	-
Health workers	3	3	-	-
Social workers	2	2	-	-
Total	n=16	n=16	n=20	N=20

Table 3.9 above shows that the proportion of subjects recruited into the follow-up study from the trained cohort was 37% (n=32/86). There were similar numbers of subjects of the trained and untrained groups recruited into this follow-up data collection of this study.

This was an adequate sample for a qualitative study to evaluate the impact of the training programme on the deaf children in five study wards.

There were seven focus group discussion sessions attended by pre-school teachers (n=18) and village community workers (n=22). A total of 40 pre-school and community workers were recruited into the study and invited to participate (n=40) at seven group discussions.

The seven groups were distributed as illustrated in Table 3.10.

Table 3.10: Focus group discussion sessions and number of subjects per session (n=40)

Session	Trained	Untrained	Total
1	7	-	7
2	-	5	5
3	4	6	10
4	-	5	5
5	5	-	5
6	4	-	4
7	-	4	4
Total	n=20	n=20	n=40

Table 3.10 shows that there were 40 people who participated in 7 group discussions carried out between May and June 2002 by the fieldworker number 2, see Table 3.4. The test instruments employed in this study were the pilot tested self-administered questionnaire and the focus group discussions guide. The instruments used were appropriate for the study.

The questionnaire had 38 total questions divided as follows:

- Questions 1-4 were asking general information about hearing loss
- Questions 5-12 were knowledge based
- Questions 13-25 were asking about attitudes
- Questions 26-37 were practice based
- Question 38 required any comment the subject felt s/he wanted to say about hearing loss in children

See the follow-up assessment questionnaire in the appendices.

All 32 subjects completed and returned the questionnaire. Their responses were coded and entered into Epi-Info 2000 database. The analysis for frequencies was done. These results are presented in Chapter 4, "Part C" of the "intervention results".

The focus group discussion guide questions were used to set the mood and probes were used to seek clarity and exploring issues emerging from the discussion.

3.11.6 Triangulation of the follow-up data collection

Triangulation is a qualitative data testing method to validate the information collected from the field. The method of triangulation is similar to testing the reliability of the information collected by checking other means or sources, such as reading from reports, observations and rating the achievements of deaf children integrated into ordinary schools. This procedure ensured that detailed and valid data were collected and more insight brought for discussion. One way of triangulation was the recruitment of subjects who were not trained by the study who were selected as controls. Deaf children who were enrolled were counted and their achievements in and outside the classroom observed by a specialist teacher of the deaf to determine the impact of the integration intervention programme on these children.

3.11.7 Data entry and analysis

The follow-up assessment questionnaires were coded and entered into the Epi-Info 2000 statistical package. The focus group sessions were tape recorded and transcribed later. A thematic analysis of the responses from the focus group discussions was done and is presented in Chapter 4 of "Part C" of the follow-up assessment results.

This leads us to Chapter 4 of this thesis that presents the results of this study which are divided into three parts as follows:

- "Part A" of Chapter 4 presents the primary results of this study, i.e. the sensitivity, specificity and reliability coefficients of the final outcomes of the "Questionnaire" screen as compared with the conventional pure-tone audiometric test outcomes whose methods are described in "Part A" of this chapter.
- "Part B" of Chapter 4 presents the additional results of this study obtained from analysing the "Two-question" recruitment tool whose methods are also described in "Part A" of this chapter.
- "Part C" of Chapter 4 presents the follow-up assessment of the training intervention of this study whose methods are described in "Part B" of this chapter.

CHAPTER 4

RESULTS

Chapter 4

4.0 Results

Chapter 4 is divided into three parts as follows:

1. "Part A" presents the primary results of this study evaluating the "Questionnaire" screen in identifying bilateral permanent hearing loss in young children in rural Zimbabwe.
2. "Part B" presents the additional results obtained from the data collected during the recruitment of subjects testing the innovative recruitment tool in identifying the at-risk children.
3. "Part C" presents the results of evaluating a simple training programme implemented as a way of ensuring provision of appropriate services for deaf children in the study area.

The main results of this study are presented in "Part A" of this chapter. The additional results are presented in "Part B" and "Part C". These additional results are equally important as those presented in "Part 1". This is because they provide evidence of how a screening programme can be useful in introducing and improving appropriate services for deaf children in rural Zimbabwe. The evidence of the effectiveness of a simple intervention such as conducting a series of 5-day training workshops for community and health workers that were organised and held in Binga in 2000/2001 is provided by the qualitative data collected 12 months later, which is presented in "Part C" of this chapter.

The next section presents the primary results of "Part A" of this chapter ascertaining the sensitivity and the specificity of the "Questionnaire" screen in identifying deaf children compared with the pure-tone screen.

Part A

4.1 Primary results

The purpose of this study was to ascertain the sensitivity and specificity of the "Questionnaire" screen in identifying deaf children as compared to the pure-tone audiometric screen. "Part A" is attempting to answer the question whether the "Questionnaire" screen correctly identified deaf children?

The objectives of the study were:

- To test the sensitivity and specificity of the "Questionnaire" screen in detecting hearing loss in children compared with the pure-tone screen
- To test the inter-and intra-user reliability of the "Questionnaire" screen

It was hypothesised that the "Questionnaire" screen could have 60% sensitivity and 70% specificity in identifying children with bilateral permanent hearing-impairment in excess of 50dBHL averaged across four frequencies: 0.5k, 1k, 2k and 4k, of the better ear.

The primary results were obtained from analysing data collected by the "Questionnaire" screen compared with the pure-tone screen used as the gold standard.

The evaluation also included the analysis of the individual questions contained in the "Questionnaire" screen to determine the performance of each question in identifying deaf children. The results of the performance of the questions are categorised as follows:

- Questions with high sensitivity and specificity
- Questions with high and medium sensitivity or questions with high and medium specificity
- Questions with high and low sensitivity or questions with high and low specificity
- Questions with medium sensitivity and specificity
- Questions with medium and low sensitivity or questions with medium and low specificity

- Questions with low sensitivity and specificity

The analysis is focused on identifying questions which performed moderately well i.e. questions which had medium sensitivity and specificity. The results testing the inter-and intra-user reliability of the "Questionnaire" screen are also described.

4.1.1 Primary data analysis

The data is analysed and the main results of this study are presented. Firstly, an analysis of the sample size, the sample distribution per ward and per age group is presented.

Secondly, the results obtained from data collected to validate the performance of the "Questionnaire" screen as compared with the pure-tone screen are presented as the core findings of this study which are found in the subsequent subsections of "Part A".

Tables 4.1 – 4.4 describe the number of children who were subjected to the first and the repeat "Questionnaire" screen and the pure-tone screen to test the overall performance of the "Questionnaire" screen. The sample sizes had been broken into first and second screen per age group and per ward.

Firstly the breakdown of the study subjects was statistically analysed and tested. Secondly, the performance of the "Questionnaire" screen against the pure-tone screen was evaluated.

Sample distribution

The distribution of subjects of the phase one (2000/2001) of the data collection of this study screened is divided into two as follows:

- "Questionnaire" screen
- Pure-tone screen

The details of the analysis and the results from the data collected by the two screens are presented in the following relevant sections.

a) "Questionnaire" screen

The data of the sample distribution of the first and the repeat "Questionnaire" screens are analysed and presented in Tables 4.1 – 4.2.

Table 4.1: below shows the number of children screened by the "Questionnaire" screen in the study wards.

Table 4.1: Children screened by the questionnaire (n=747)

Ward	Questionnaire screen results	Age in months			Total	P-value
		36-47	48-59	60-72		
1	Pass	37	32	39	108	
	Fail	7	8	6	21	0.65
	Total	**44**	**40**	**45**	**129**	
4	Pass	25	26	33	84	
	Fail	5	10	6	21	0.14
	Total	**30**	**36**	**39**	**105**	
5	Pass	31	35	40	106	
	Fail	1	3	2	6	0.77
	Total	**32**	**38**	**42**	**112**	
17	Pass	71	72	76	219	
	Fail	13	7	21	41	0.12
	Total	**84**	**79**	**97**	**260**	
21	Pass	46	31	38	115	
	Fail	6	9	11	26	0.40
	Total	**52**	**40**	**49**	**141**	
Five wards	Pass	210	196	226	632	
	Fail	32	37	46	115	0.42
	Total	**242**	**233**	**272**	**747**	

The sample size of 747 children was included in this study by the use of the two-question recruitment tool as described in the methodology chapter. The number of children (n=747) screened by the "Questionnaire" per ward and compared in the three age groups showed no difference (p>0.05). Table 4.1 above presents a breakdown of the number of children aged 36-72 months subjected to the "Questionnaire" screen in five selected wards.

The number of children recruited was similar in the study wards (p>0.05). There were similar numbers of children who showed some indication of hearing loss in the five wards and among different age groups (p>0.05). A total of 115 (15.4%) children were picked by the “Questionnaire” screen as showing some indication of hearing loss and 632 (84.6%) children passed the “Questionnaire” screen.

There was a similar distribution of children who were identified by the “Questionnaire” screen as having some indication of hearing loss from the study wards and in the three age groups (p>0.05).

Table 4.2 below presents the number of children who were repeating the “Questionnaire” screen to test inter and intra-user tester reliability.

Table 4.2: Children repeat screened by the **“Questionnaire”** screen (n=131)

Ward	Indication of hearing loss	Age in months			Total	P-value
		36-47	48-59	60-72		
1	Pass	3	4	4	11	
	Fail	1	1	2	4	0.88
	Total	**4**	**5**	**6**	**15**	
4	Pass	6	7	6	19	
	Fail	2	2	4	8	0.81
	Total	**8**	**9**	**10**	**27**	
5	Pass	-	7	2	9	
	Fail	5	1	3	9	0.05
	Total	**5**	**8**	**5**	**18**	
17	Pass	12	9	7	28	
	Fail	1	1	3	5	0.29
	Total	**13**	**10**	**10**	**33**	
21	Pass	14	8	8	30	
	Fail	3	1	4	8	0.42
	Total	**17**	**9**	**12**	**38**	
Five wards	No	35	35	27	97	
	Yes	12	6	16	34	0.50
	Total	**47**	**41**	**43**	**131**	

Table 4.2 above shows the numbers of children repeat screened by the “Questionnaire” screen (n=131). These children were randomly selected from a sample of 747 children. The analysis of this sub-sample showed that the subjects were evenly spread in the study area and per age group with the exception of ward 5, which included slightly more children aged 48-59 months than in the other age groups 36-47 and 60-72 months respectively (5: 8: 5) (p<0.05). Overall, the sample size subjected for the repeat screen was evenly spread in five wards and per the three age groups (p>0.05).

b) Pure-tone screen

The data of the sample distribution of the first and the repeat pure-tone screens are analysed and presented in Tables 4.3 to 4.4.

Table 4.3: Pure-tone screened children (n=747)

Ward	Pure-tone screen	Age in months: number of children/age group			Total	P-value
		36-47	48-59	60-72		
1	Pass	25	31	37	93	0.0001
	Difficulty testing	16	4	-	20	0.132
	Fail	1	5	7	13	0.58
	Non co-operating	2	-	1	3	-
	Total	**44**	**40**	**45**	**129**	0.18
4	Pass	15	25	34	74	0.001
	Difficulty testing	11	2	2	15	0.06
	Fail	2	9	3	14	0.46
	Non co-operating	2	-	-	2	0.47
	Total	**30**	**36**	**39**	**105**	0.25
5	Pass	8	9	31	48	0.0001
	Difficulty testing	16	19	4	39	0.56
	Fail	7	9	6	22	0.75
	Non co-operating	1	1	1	3	0.0001
	Total	**32**	**38**	**42**	**112**	0.33
17	Pass	57	67	81	205	0.0001
	Difficulty testing	17	2	1	20	0.10
	Fail	2	8	13	23	0.008
	Non co-operating	8	2	1	11	0.75
	Total	**84**	**79**	**96**	**260**	0.21
21	Pass	32	34	41	107	0.0001
	Difficulty testing	11	1	-	12	0.94
	Fail	7	5	7	19	0.84
	Non co-operating	2	-	1	3	0.63
	Total	**52**	**40**	**49**	**141**	0.60
Five wards	Pass	137	166	225	528	0.0001
	Difficulty testing	71	28	7	106	0.33
	Fail	19	36	36	91	0.41
	Non co-operating	15	3	4	22	0.37
	Total	**242**	**233**	**272**	**747**	0.28

Table 4.3 above shows the numbers of children who were pure-tone screened by the audiologist (n=747). The analysis of this sample showed that the subjects were evenly spread in the study area. There were a significant number of children who passed ($p<0.005$) compared to children who failed the screen and those who were difficult to test ($p>0.05$). Overall, the subjects who were pure-tone screened were evenly spread in the five wards and among the three age groups ($p>0.05$).

Table 4.4 below presents the sample size break down of the repeat pure-tone screen.

Table 4.4: Repeat pure-tone screened children (n=110)

Ward	Pure-tone screen	Age in months: number of children/age group			Total	P-value
		36-47	48-59	60-72		
1	Pass	8	6	5	19	0.53
	Difficulty testing	1	-	-	1	-
	Fail	-	-	-	-	-
	Non co-operating	1	-	-	1	-
	Total	**10**	**6**	**5**	**21**	0.53
4	Pass	3	5	9	17	0.04
	Difficulty testing	3	-	-	3	0.12
	Fail	-	1	1	2	0.56
	Non co-operating	-	1	-	1	-
	Total	**6**	**7**	**10**	**23**	0.24
5	Pass	-	-	1	1	-
	Difficulty testing	-	-	-	-	-
	Fail	2	1	-	3	0.14
	Non co-operating	-	-	-	-	-
	Total	**2**	**1**	**1**	**4**	0.14
17	Pass	13	13	12	38	0.35
	Difficulty testing	2	-	-	2	0.71
	Fail	3	1	-	4	0.74
	Non co-operating	2	1	-	3	0.14
	Total	**20**	**15**	**12**	**47**	0.48
21	Pass	4	4	6	14	0.45
	Difficulty testing	-	-	-	-	-
	Fail	1	-	-	1	-
	Non co-operating	-	-	-	-	-
	Total	**5**	**4**	**6**	**15**	0.45
Five wards	Pass	28	28	33	89	0.27
	Difficulty testing	6	-	-	6	0.42
	Fail	6	3	1	10	0.48
	Non co-operating	3	2	-	5	0.14
	Total	**43**	**33**	**34**	**110**	0.33

Table 4.4 above shows the numbers of children who had a repeat pure-tone screen (n=110). An analysis of this sample showed that the subjects were evenly spread in the study area and per age group (p>0.05). The repeat pure-tone screen was undertaken to confirm the results obtained by the audiologist. Sixty-six (66) children were re-tested by the audiologist for inter/intra-user reliability and his two trained assistants re-tested 44 children for inter-user reliability.

The performance of the "Questionnaire" screen was evaluated in two forms: statistically testing for significance and by using the model illustrated by Table 3.6 in the methods chapter. These results are presented in the relevant subsections below.

4.1.2 Evaluation of the performance of the "Questionnaire" screen

The results obtained from analysing data collected for evaluation of the performance of the "Questionnaire" screen are presented and described in this section. The results of statistically testing the "Questionnaire" screen in identifying hearing loss in excess of 50dBHL across four frequencies (0.5k, 1k, 2k and 4k) are also presented.

The evaluation of the performance of the "Questionnaire" screen against the pure-tone screen determined the validity of the screen in identifying permanent hearing impairment in children. The pure-tone screen was set at a cut off point of 50dBHL in identifying hearing loss in the better ear. The repeat "Questionnaire" and pure-tone screens were also analyzed and compared.

The "Questionnaire" screen's sensitivity and specificity was worked out to determine its overall performance in identifying deaf children. The results comparing the "Questionnaire" screen with the pure-tone screen are presented in the subsequent tables.

a) Statistical testing of the performance of the "Questionnaire" screen

The Yates corrected statistics was used to test the significance of the "Questionnaire" screen in identifying hearing loss in children. The "Questionnaire" screen was compared with the pure-tone screen in identifying hearing loss in excess of 50dBHL of the better ear in 747 children screened by both protocols.

Tables 4.5-4.7 present the statistical tests for any difference between the "Questionnaire" screen and the pure-tone screen in identifying deaf children of ages 36-72 months. Table 4.5 shows the statistical significance test results of the performance of this screen among the three age groups (36-47 months; 48-59 months and 60-72 months) of the subjects. It was hypothesised that there is no difference in the performance of the "Questionnaire" screen compared with the pure-tone screen in identifying deaf children.

The analysis excluded children who were either difficult to test or non co-operating as mentioned earlier on in the methods chapter. The pure-tone screen versus the "Questionnaire" screen results are presented in Tables 4.5 to 4.14 below.

Table 4.5 presents the analyses of the age distribution of the sample of the study screened by the "Questionnaire" screen compared with the pure-tone screen (n=747)

Table 4.5: Age groups of children screened by the first "Questionnaire" screen compared with the first pure-tone screen (n=747)

Age in Months	Questionnaire screen	Pure-tone Screen				Total	P-value
		Pass	Difficulty testing	**Fail**	Non co-operating		
36-47	Pass	**135**	61	**2**	12	210	0.71
	Fail	**2**	10	**17**	3	32	
	Total	**137**	**71**	**19**	**15**	**242**	
48-59	Pass	**160**	25	**9**	2	196	0.07
	Fail	**6**	3	**27**	1	37	
	Total	**166**	**28**	**36**	**3**	**233**	
60-72	Pass	**209**	7	**8**	2	226	0.27
	Fail	**16**	-	**28**	2	46	
	Total	**225**	**7**	**36**	**4**	**272**	
36-72	Pass	**504**	93	**19**	16	632	0.35
	Fail	**24**	13	**72**	6	115	
	Total	**528**	**106**	**91**	**22**	**747**	

Table 4.5 above presents the results obtained on 747 children by using both protocols, namely the "Questionnaire" and the pure-tone screens. The analysis was performed per age group. The results show that there were similarities (p>0.05) in the performance of the "Questionnaire" screen compared with the pure-tone screen in identifying the defined hearing loss in the study sample within the three age groups (36-47 months, 48-59 months and 60-72 months).

Nevertheless, in the age group 48-59 months results showed the "Questionnaire" screen performed at a borderline (0.05<p<0.10) compared to its performance in the other age groups. This low performance of this screen in the age group 48-59 months compromised the effectiveness of the screen in identifying deaf children.

The next table presents the age distribution and the results of the statistical tests performed on a random sample (n=131) selected for the repeat questionnaire screen compared with the pure-tone screen (see Table 4.6 below).

Table 4.6: Children using the repeat "Questionnaire" screen compared with the first pure-tone screen per age group (n=131)

Age in months	Questionnaire screen	Pure-tone Screen				Total	P-value
		Pass	Difficulty testing	**Fail**	Non co-operating		
36-47	Pass	**25**	11	**1**	3	40	0.07
	Fail	**1**	-	**5**	1	7	
	Total	**26**	**11**	**6**	**4**	**47**	
48-59	Pass	**23**	5	**6**	1	35	0.90
	Fail	**-**	1	**5**	-	6	
	Total	**23**	**6**	**11**	**1**	**41**	
60-72	Pass	**22**	-	**5**	-	27	0.30
	Fail	**10**	-	**6**	-	16	
	Total	**32**	**-**	**11**	**-**	**43**	
36-72	Pass	**75**	16	7	4	102	0.42
	Fail	**6**	1	21	1	29	
	Total	**81**	**17**	**28**	**5**	**131**	

Table 4.6 above presents the results of statistically testing the data obtained on 131 children screened by both protocols. The analysis and statistical testing was performed on the three age groups (36-47 months, 48-59 months and 60-72 months) and the results show that there was no difference in the performance of the repeat "Questionnaire" screen compared with the pure-tone screen in all three age groups ($p>0.05$).

The further analysis of the results used a decision matrix model comparing the "Questionnaire" screen's performances with the pure-tone screen as described in the methods chapter are presented in Tables 4.7 to 4.10.

Table 4.7: The “Questionnaire” compared with the pure-tone screening results (n=619)

Questionnaire screen	Pure-tone screen		**Total**
	Pass	Fail	
Pass	504	19	**523**
Fail	24	72	**96**
Total	**528**	**91**	**619**

Table 4.8 shows that the “Questionnaire” screen’s performance was: the sensitivity (72/91) = 79% and specificity (504/528) = 96%; predictive value for positive (72/96) = 75%; predictive value for negative (504/523) = 96% and the overall performance (576/619) = 93% (P>0.05). This means that the questionnaire identified 93% of 619 children as having hearing/non hearing loss correctly in the study sample (n=619).

Tables 4.8 – 4.10 present the results of the performance of the “Questionnaire” screen in the three age groups (36-47 months, 48-59 months and 60-72 months)

Table 4.8: The 1st “Questionnaire” compared with the 1st pure-tone screening results for 36 – 47 months age group (n=156)

Questionnaire screen	Pure-tone screen		**Total**
	Pass	Fail	
Pass	135	2	**137**
Fail	2	17	**19**
Total	**137**	**19**	**156**

Table 4.8 shows that the “Questionnaire” screen’s performance was: sensitivity (17/19) = 89% and specificity (135/137) = 99%; predictive value for positive (17/19) = 90%; predictive value for negative (135/137) = 99% and the overall performance (152/156) = 97% (P>0.05).

The first “Questionnaire” screen was compared with the first pure-tone screen for ages between 48 – 59 months (see Table 4.9).

Table 4.9: The 1st "Questionnaire" compared with the 1st pure-tone screening results for 48 – 59 months age group (n=202)

Questionnaire screen	Pure-tone screen		Total
	Pass	Fail	
Pass	160	9	**169**
Fail	6	27	**33**
Total	**166**	**36**	**202**

Table 4.9 shows that the "Questionnaire" screen's performance was: sensitivity (27/36) = 75% and specificity (160/166) = 96%; predictive value for positive (27/33) = 82%; predictive value for negative (160/169) = 95% and the overall performance (187/202) = 93% (P>0.05).

The first "Questionnaire" screen was compared with the first pure-tone screen for ages between 60 - 72 months see Table 4.10 below.

Table 4.10: The 1st "Questionnaire" compared with the 1st pure-tone screening results for 60 – 72 months age group (n= 261)

Questionnaire screen	Pure-tone screen		Total
	Pass	Fail	
Pass	209	8	**217**
Fail	16	28	**44**
Total	**225**	**36**	**261**

Table 4.10 shows that the "Questionnaire" screen's performance was: sensitivity (28/36) = 77% and specificity (209/225) = 93%; predictive value for positive (28/44) = 64; predictive value for negative (209/217) = 96% and the overall performance (237/261) = 91% (P>0.05).

The performance of the first "Questionnaire" screen compared with the first pure-tone screen for ages: 36 – 47 months; 48 – 59 months and 60 – 72 months (range 36 - 72 months) is summarised in Table 4.11.

Table 4.11: The summary results of the 1st "Questionnaire" screen compared with the 1st pure-tone screen for ages 36 – 72 months

Sample (n=619)			
Age in months	**Total number**	**Sensitivity %**	**Specificity %**
36-47	156	89	99
48-59	202	75	96
60-72	261	77	93
36-72	**619**	**80**	**96**

Table 4.11 shows that the "Questionnaire" screen's performance for the three age groups is summarised as follows: the average sensitivity and specificity of the screen was 80% and 96% respectively.

Analysis of the repeat "Questionnaire" screen using the decision "matrix analysis" model described in the methods chapter, for test performance characteristics of the "Questionnaire" screen was used. The formulae of this model are used for calculation of the sensitivity and specificity; the predictive value for positive and predictive value for negative and the overall performance of the "Questionnaire" screen.

This model demonstrated how constant the screen was in identifying hearing loss in children in the three age groups (36-47 months, 48-59 months and 60-72 months). These results are presented in Tables 4.13 – 4.16 below.

Table 4.12: The 2nd "Questionnaire" compared with the 1st pure-tone screening results for 36 – 47 months age group (n=32)

Questionnaire screen	Pure-tone screen		**Total**
	Pass	Fail	
Pass	25	1	**26**
Fail	1	5	**6**
Total	**26**	**6**	**32**

Table 4.12 shows that the repeat "Questionnaire" screen's performance was: sensitivity (5/6) = 83% and specificity (25/26) = 96%; predictive value for positive (5/6) = 83%; predictive value for negative (25/26) = 96% and the overall performance (30/32) = 94% (P>0.05).

The second "Questionnaire" screen was compared with the first pure-tone screen for ages 48 - 59 months (see Table 4.13 below).

Table 4.13: The 2nd "Questionnaire" compared with the 1st pure-tone screening results for 48 – 59 months age group (n=34)

Questionnaire screen	Pure-tone screen		**Total**
	Pass	Fail	
Pass	23	6	**29**
Fail	-	5	**5**
Total	**23**	**11**	**34**

Table 4.13 shows that the "Questionnaire" screen's performance was: sensitivity (5/11) = 46% and specificity (23/23) = 100%; predictive value for positive (5/5) = 100%; predictive value for negative (23/29) = 79% and the overall performance (28/34) = 82% (P>0.05).

The second "Questionnaire" screen was compared with the first pure-tone screen for ages 60 - 72 months (see Table 4.14 below).

Table 4.14: The 2nd "Questionnaire" compared with the 1st pure-tone screening results for 60 – 72 months age group (n=43)

Questionnaire screen	Pure-tone screen		**Total**
	Pass	Fail	
Pass	22	5	**27**
Fail	10	6	**16**
Total	**32**	**11**	**43**

Table 4.14 shows that the "Questionnaire" screen's performance was: sensitivity (21/28) = 75% and specificity (75/81) = 93%; predictive value for positive (72/96) = 75%; predictive value for negative (504/523) = 96% and the overall performance (576/619) = 93% (P>0.05).

The performance of the second "Questionnaire" screen compared with the first pure-tone screen for ages: 36 – 47 months; 48 – 59 months and 60 – 72 months (range 36 - 72 months) is summarised in Table 4.15.

Table 4.15: The summary results of the 2nd "Questionnaire" screen compared with the 1st pure-tone screen for ages 36 – 72 months

Sample (n=109)			
Age in months	**Total number**	**Sensitivity %**	**Specificity %**
36-47	32	83	96
48-59	34	46	100
60-72	43	75	93
36-72	**109**	**68**	**96**

The results of the performance of the repeat "Questionnaire" screen for all three age groups are summarised in Table 4.15 above as follows: sensitivity/specificity = 68% and 96% respectively.

The repeat "Questionnaire" screen results presented in Table 4.15 above are consistent with the earlier findings obtained from analysing the first "Questionnaire" screen data in Table 4.11.

The individual questions contained in the "Questionnaire" screen were also evaluated to determine each question's performance in identifying deaf children in the sample group. These results are presented in subsequent sections.

4.1.3 Evaluation of the individual questions contained in the "Questionnaire" screen

This section presents the results obtained from analysing the individual questions contained in the "Questionnaire" screen field tested in Zimbabwe. The "Questionnaire" is divided into two parts. "Part 1" has 8 questions for every child. "Part 2" is sub-divided into sections for specific age groups: "Section A" for ages 36-47 months has 10 questions, "Section B" for ages 48-59 months has 10 questions and "Section C" for ages 60-72 months has 10 questions. Each child is asked 18 questions in all.

Further to the 18 questions for each child, the interviewer performs two simple observation tests. The child is required to follow the instructions given by the interviewer and the mother or carer and the observation is recorded as a "yes" or "no" response. The interviewer then summarises the responses observed from each child on a scale graded from 0-10 (0=no response to 10=always).

Looking at the reliability of each question, statistical tests were performed on their performance in identifying hearing loss in excess of 50dBHL across four frequencies (0.5k, 1k, 2k and 4k).

The results of the responses from each question and observation test were compared against the pure-tone screen. The results of the performance of each question and each section are presented in Tables 4.16– 4.19.

There was a mixed result of highly, moderate and low sensitive questions of the "Questionnaire" screen. A highly sensitive question has $\geq$70% sensitivity, a moderately sensitive question has a sensitivity between 50 and 69% and a lowly sensitive question has <50% sensitivity.

The individual questions contained in Part 1" the General Section of the "Questionnaire" screen were evaluated to determine each question's performance in identifying deaf children in the sample group. These results are presented in the next subsection.

4.1.4 Performance of "Part 1" the General Section of the "Questionnaire" screen

This part of the "Questionnaire" screen has 8 questions for every child between 36 and 72 months of age (n=747). The data were analysed to determine the specific questions in this section of the screen.

Questions 1 to 7 of the "Questionnaire" screen were collecting bio-data information and were not included in the analysis and results presented. Questions included in the analysis are those found in "Part 1" (For every child) and "Part 2" (for each child), "Sections A, B and C" of the "Questionnaire" screen. The results were obtained from comparing the performance of each question of the "Questionnaire" screen with the pure-tone screen. These results are presented in subsequent subsections.

Table 4.16: Part 1 (For every child) of the "Questionnaire" screen compared with the pure-tone screen (n=747)

Part 1: General Questions	Pure-tone screen					P-value
	Sensitivity %	Specificity %	Predictive value of positive %	Predictive value of negative %	Overall %	
Q8	51	79	4	100	78	0.93
Q9	34	94	11	96	90	0.30
Q10	11	93	8	96	90	0.83
Q11	9	96	11	95	92	0.02
Q12	0	96	0	94	92	0.75
Q13	20	84	5	95	77	0.74
Q14	37	75	5	95	68	0.97
Q15	30	88	6	95	84	0.91
Average	**24**	**88**	**6**	**96**	**84**	**0.68**

Notes:

Q = is a notation for the question (Q) of the "Questionnaire" screen

Table 4.16 presents the results of the performance of each question in "Part 1" of the "Questionnaire" screen compared with the pure-tone screen (n = 747). There is no question in Part 1 with a sensitivity of >70%.

The results of the performance of "Part 1" of the "Questionnaire" screen with 8-questions are summarised as follows: the sensitivity was 24%; the specificity was 88%; predictive value for positive was 6%; predictive value for negative was 96%; the overall performance of Part 1 of this screen in identifying children with and without hearing loss was 84%.

The performance of "Part 1" of the "Questionnaire" screen is summarised as follows:

a) Sensitivity
   - Four questions (Qs: 8, 9, 14 and 15) had a marginal moderate sensitivity between 30 and 51%.
   - Four questions (Qs: 10, 11, 12 and 13) had a low sensitivity of <30%.

b) Specificity

- All eight questions (Qs: 8, 9, 10, 11, 12, 13, 14 and 15) have high specificity >70%. .

"Part 1" of the "Questionnaire" screen performed moderately well as illustrated by these questions: one question (Q8) had sensitivity between 50 and 70%. Three questions (Qs: 9, 14 and 15) had sensitivity between 30 and 49%. Four questions (Qs: 10, 11, 12 and 13) had sensitivity <30%.

The questions in "Part 1" had high specificity and low sensitivity. Nine of the ten questions identified >77% children with and without hearing loss in a sample group of 747 children (n=747) but one (Q14) had an overall performance of 68%.

This section generally performed moderately well in identifying 747 children with and without moderate hearing loss (≥50dBHL) in four frequencies; 0.5k, 1k, 2k and 4k.

The individual questions contained in "Part 2" (for each child) "Sections A, B and C" specific for ages: 36 – 47 months; 48 – 59 months and 60 - 72 months, of the "Questionnaire" screen were evaluated to determine each question's performance in identifying deaf children in the sample group. These results are presented in the subsequent subsections.

4.1.5 Performance of "Part 2" "Section A" of the "Questionnaire" screen

"Section A" of the "Questionnaire" screen has 10 questions and two observation tests for each child aged 36-47 months (n=242). The data were analysed to determine the specific questions in this section of the screen.

Table 4.17 presents the results of each question and a summarised evaluation of "Section A" of Part 2 against the pure-tone screening results of 242 children.

Table 4.17: "Part 2", "Section A" of the "Questionnaire" screen (Specific age group of the child aged 36-47 months) compared with the pure-tone screen (n=242)

Part 2 'Section A' questions	Pure-tone screen					P-value
	Sensitivity %	Specificity %	Predictive value of positive %	Predictive value of negative %	Overall %	
Q16	3	98	16	88	86	0.76
Q17	5	97	13	91	88	0.99
Q18	5	98	25	90	87	0.93
Q19	93	10	12	87	20	0.002
Q20	20	89	16	88	80	0.19
Q21	46	66	16	89	63	0.34
Q22	8	94	22	88	84	0.22
Q23	27	70	14	88	66	0.46
Q24	97	2	12	73	14	0.14
Q25	2	98	18	88	86	0.85
OB1	3	98	18	88	86	0.04
OB2	2	96	12	88	85	0.44
Average	**26**	**76**	**16**	**87**	**70**	**0.45**

Notes:

Q=Question, OB=Observation test, --------- this broken line separates the questions (Qs) and the observation tests (OBs).

Table 4.17 presents the results of the performance of each question in "Part 2" "Section A" of the "Questionnaire" screen compared with the pure-tone screen results (n = 242).

The summary of the performance of "Section A" of the "Questionnaire" screen is as follows:

a) Sensitivity

- Two questions (Qs: 19 and 24) have a high sensitivity of >70%
- One question (Q21) has a marginal moderate sensitivity between 30 and 49%.
- Seven questions (Qs: 16, 17, 18, 20, 22, 23 and 25) have low sensitivity of <30%.

b) Specificity:

- Seven questions (Qs: 16, 17, 18, 20, 22, 23 and 25) have a high specificity >70%.
- And only two questions (Qs: 19 and 24) have very low specificity.
- The two observation tests (OB1 and OB2) have high specificity

Ten questions and two observations of "Section A" (Qs: 16, 17, 18, 19, 20, 21, 22, 23, 24 and 25 plus two observation tests: OB1 and OB2) of this screen identified 70% children with/out hearing loss in a sample group of 242 children (n=242).

The results of the performance of 'Part 2' 'Section A' (for children 36-47 months) of the "Questionnaire" screen with 10-questions are summarised as follows: sensitivity was 26%; specificity was 76%; predictive value for positive was 16%; predictive value for negative was 87%; the overall performance of "Section A" of this screen in classifying children with/out moderate hearing loss was 70% (see Table 4.17).

The individual questions contained in "Part 2" "Section B" specific for ages: 48 – 59 months of the "Questionnaire" screen were evaluated to determine each question's performance in identifying deaf children in the sample group. These results are presented in the next subsection.

4.1.6 Performance of "Part 2" "Section B" of the "Questionnaire" screen

"Section B" of the "Questionnaire" screen has 10 questions and two observation tests for each child for ages 48-59 months (n=233). These data were also analysed to determine the specific questions in this section of the screen.

The results of "Part 2", 'Section B' of the "Questionnaire" screen (Specific age group of the child aged 48-59 months) compared with the pure-tone screen results are presented in Table 4.18.

Table 4.18: "Part 2", 'Section B' of the "Questionnaire" screen (Specific age group of the child aged 48-59 months) compared with the pure-tone screen results (n=233)

Part 2 'Section B' questions	Pure-tone screen					P-value
	Sensitivity %	Specificity %	Predictive value of positive %	Predictive value of negative %	Overall %	
Q26	3	98	18	92	91	0.40
Q27	10	90	13	93	84	0.04
Q28	72	9	8	93	16	0.14
Q29	17	91	9	92	85	0.50
Q30	14	63	6	91	60	0.54
Q31	91	12	7	89	17	0.21
Q32	11	82	9	93	78	0.94
Q33	32	79	14	94	75	0.10
Q34	18	90	10	93	84	0.47
Q35	18	97	14	92	90	0.01
OB1	2	98	15	93	92	0.02
OB2	28	98	19	93	91	0.001
Average	**26**	**76**	**12**	**92**	**72**	**0.28**

Notes:

Q=Question, OB=Observation test, --------- this broken line separates the questions (Qs) and the observation tests (OB).

Table 4.18 presents the results of the performance of each question in "Section B" of the "Questionnaire" screen compared with the pure-tone screen (n=233).

The summary of Table 4.18 of the performance of "Section B" of 'Part 2' (specific age group of the child) of the "Questionnaire" screen with 10-questions and two observation tests has a sensitivity of 26%; a specificity of 76%; the predictive value for positive was 12%; the predictive value for negative was 92%, and the overall performance of this section of the screen in classifying children with/out hearing loss correctly was 72%.

The performance of "Part 2" "Section B" of the "Questionnaire" screen showed the following results:

a) Sensitivity

- Two questions (Qs: 28 and 31) have high sensitivity of >70%
- One question (Q33) has a marginal moderate sensitivity between 30 and 49%.
- Seven questions (Qs: 26, 27, 29, 30, 32, 34 and 35) have low sensitivity of <30%.

b) Specificity

- Seven questions (Qs: 26, 27, 29, 30, 32, 34 and 35) have high specificity >70%.
- And only two questions (Qs: 28 and 31) have very low specificity.
- The two observation tests (OB1 and OB2) have high specificity >70%.

Ten questions and two observations of "Section B" of Part 2 (Qs: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, OB1 and OB2) of the "Questionnaire" screen identified 72% children with/out hearing loss in a sample group of 233 children (n=233).

The individual questions contained in Part 2" "Section C" specific for ages: 60-72 months of the "Questionnaire" screen were evaluated to determine each question's performance in identifying deaf children in the sample group. These results are presented in the next subsection

4.1.7 Performance of "Part 2" "Section C" of the "Questionnaire" screen

"Section C" of the "Questionnaire" screen has 10 questions and two observation tests for each child for ages 60-72 months (n=272). These data obtained from 272 children were analysed to determine the specific questions in this section of the screen and the results are presented in Table 4.19.

Table 4.19: Part 2, 'Section C' (Specific age group of children aged 60-72 months) of the "Questionnaire" screen compared with the pure-tone screen results (n=272)

"Part 2" " "Section C" questions	Pure-tone screen					P-value
	Sensitivity %	Specificity %	Predictive value of positive %	Predictive value of negative %	Overall %	
Q36	2	99	13	96	95	0.77
Q37	15	87	3	96	84	0.35
Q38	99	9	5	98	13	0.99
Q39	40	63	4	96	62	0.03
Q40	85	11	4	96	14	0.78
Q41	30	80	4	96	77	0.41
Q42	99	5	4	98	9	0.94
Q43	32	77	5	96	75	0.87
Q44	15	92	5	96	88	0.66
Q45	1	97	3	96	93	0.99
OB1	1	99	13	96	95	0.93
OB2	1	99	6	96	94	0.76
Average	**35**	**68**	**6**	**96**	**67**	**0.71**

Notes:

Q=Question, OB=Observation test, --------- this broken line separates the questions (Qs) and the observation tests (OB).

The summary of Table 4.19 of the performance of "Section C" of 'Part 2' (specific age group of the child) of the "Questionnaire" screen with 10-questions had a sensitivity of 35% has a specificity of 68%; the predictive value for positive was 6%; the predictive value for negative was 96%, and the overall performance of this section in classifying children with/out hearing loss correctly was 67%.

The results of the performance of each question in "Section C" of Part 2 of this screen compared with the pure-tone screen (n=272) show the following outcomes:

a) Sensitivity

- Three questions (Qs: 38, 40 and 42) have high sensitivity of >70%
- Three questions (Qs: 39, 41 and 43) have marginal moderate sensitivity between 30 and 49%.
- Four questions (Qs: 36, 37, 44 and 45) have very low sensitivity of <30%.

b) Specificity

- But six questions (Qs: 36, 37, 41, 43, 44 and 45) have high specificity.
- And only three questions (Qs: 38, 40, 42) have very low specificity.
- The two observation tests (OB1 and OB2) have high specificity

Ten questions and two observations of "Section C" (Qs: 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, OB1 and OB2) of the "Questionnaire" screen identified 67% children with/out hearing loss in a sample group of 233 children (n=233).

As mentioned already, there are two observation tests for each child performed by the interviewer. The interviewer on each section of the "Questionnaire" screen records these observation tests. S/he is required to summarise her/his observations on the scale provided on the top copy of this tool. The scale is graded from 0 to 10 (0 being no response to sound and 10 meaning the child always responded).

The results of the scale of the "Questionnaire" screen are presented in Table 4.20 below.

Table 4.20: "Questionnaire" screen scale compared with the pure-tone screen (n=747)

Questionnaire Screen	Pure-tone screen					
Observational scale	Sensitivity %	Specificity %	Predictive value of positive %	Predictive value of negative %	Overall %	P-value
≥4	50	91	39	100	93	0.60
<4	3	99	0	99	99	0.50
Average	**27**	**95**	**20**	**99**	**96**	**0.55**

The results of the performance of the observation scale of the "Questionnaire" screen presented in Table 4.20 above are summarised as follows:

- Scale ≥4 are: sensitivity/specificity = 50% and 91% respectively; predictive values for positive/negative = 39% and 100% respectively; overall: 93%
- Scale <4 are: sensitivity/specificity = 3% and 99% respectively; predictive values for positive/negative = 0% and 99% respectively; overall: 96%

The "Questionnaire" screen's performance is evaluated as follows: the sensitivity and specificity were 79% and 96% respectively; the predictive values for positive and negative were 75% and 96% respectively; and the overall performance of this screen was 79.8%. The results of the performance on the questions of the "Questionnaire" screen in identifying deaf children when compared with the pure-tone screen were analysed and have been described in the previous subsections of this chapter.

The next section classifies the performance of the individual questions of the "Questionnaire" screen for "Part 1" and "Part 2" "Sections: A, B and C" for the purpose of eliminating questions with low sensitivity and specificity of the recommended questions (See Appendix XVIII).

4.1.8 Classification of the performance of the questions of the "Questionnaire" screen for "Part 1" and "Part 2" "Sections: A, B and C"

This section attempts to classify the performance of the questions of the "Questionnaire" screen and group them according to their levels of sensitivity and specificity in identifying deaf children with bilateral permanent hearing loss in excess of 50dBHL compared with the pure-tone screen.

The performance on the questions of the "Questionnaire" screen for "Part 1" and "Part 2" (Sections: A, B and C) was evaluated as follows:

- Questions with high sensitivity and specificity
- Questions with high and medium sensitivity or high and medium specificity
- Questions with high and low sensitivity or high and low specificity
- Questions with medium sensitivity and specificity
- Questions with medium and low sensitivity or medium and low specificity
- Questions with low sensitivity and specificity

The classification of the questions contained in the "Questionnaire" screen was performed to separate the questions with high, moderate and low performance.

This analysis assists to refine the "Questionnaire" screen further to optimise its performance to identify bilateral permanent hearing loss in children. The data obtained from the first "Questionnaire" and pure-tone screens were analysed and classified according to the categories spelt out above. The classifications are presented in Tables 4.21-4.25 of subsequent subsections.

The individual questions contained in Part 1" (for every child) of the "Questionnaire" screen were classified according to the categories mentioned above on how each question performed in identifying deaf children in the sample group. These results are presented in the next subsection.

4.1.9 Classification of the performance of "Part 1" of the "Questionnaire" screen

The analysis for classifying the performance of "Part 1" (for every child) of the "Questionnaire" screen is presented in this subsection. The classification of the sensitivity (+ve) and specificity (-ve) of each question of the "Questionnaire" screen has shown questions which were more useful and performed well in identifying deaf children.

These useful questions were defined as having performed as follows:

- Questions with high sensitivity and specificity
- Questions with high and medium sensitivity or high and medium specificity
- Questions with high and low sensitivity or high and low specificity
- Questions with medium sensitivity and specificity

The classification of the performance of each question of Part 1 (for every child) of the "Questionnaire" screen is summarised by the sensitivity (+ve) and specificity (-ve) of these questions compared with the pure-tone screen (see Table 4.21).

Table 4.21: Part 1 (for all age groups) of the "Questionnaire" screen's sensitive (+ve) and specific (-ve) questions compared with the pure-tone screen results (n=747)

	Pure-tone screen											
"Part 1" "General". questions	High/high (+ve & -ve) questions: ≥ 90%		High/ medium (+ve & –ve) questions: ≥ 90% & ≥ 50%		High/low (+ve & -ve) questions: ≥90% & <50%		Medium/ medium (+ve & -ve) questions: ≥ 50%		Medium/ low (+ve & -ve) questions: ≥ 50% and <50%		Low/low (+ve &-ve) questions: <50%	
	+ve %	-ve %	+ve %	-ve %	+ve %	-ve %	+ve %	-ve %	+ve %	-ve %	+ve %	-ve %
Q8							51	79				
Q9					34	94						
Q10					11	93						
Q11					9	96						
Q12					0	96						
Q13									20	84		
Q14									37	75		
Q15									30	88		

Notes:

Q=Question.

Table 4.21 shows that the performance of the questions (Qs) of the "Questionnaire" screen were classified from high to low. The blank spaces in Table 4.21 signify that no question of the screen fell into these categories. These blank spaces are kept here to show the categories where these questions are missing.

The results of the performance of "Part 1" of the "Questionnaire" screen with 8-questions are summarised as follows: sensitivity = 24%; specificity = 88%; predictive value for positive = 6%; predictive value for negative = 96%; overall = 72%, see Table 4.6.

In Table 4.21 above, there was one question (Q8) with medium sensitivity and specificity. Four questions (Qs: 9, 10, 11 and 12) had high specificity and low sensitivity. Three questions (Qs: 13, 14 and 15) had medium specificity and low sensitivity. "Part 1" of the "Questionnaire" screen had no questions, which were found with high, high and medium, and low sensitivity or specificity.

However, the six out of eight questions, which were able to identify >80% of children with and without hearing loss in excess of 50dBHL in the sample were (Qs: 9, 10, 11, 12, 13 and 15). The remainder (Qs: 8 and 14) identified between 75 and 79% of the sample correctly.

The individual questions contained in "Part 2" "Section A" (Specific age of each child), for ages: 36 – 47 months, of the "Questionnaire" screen were classified according to their performance i.e. their sensitivity (+ve) and specificity (-ve) in identifying deaf children compared with the pure-tone screen. These results are presented in the next subsection.

4.1.10 Classification of the performance of "Sections A" of the "Questionnaire" screen for children aged 36-47 months

The analysis and the results for classifying the performance of the questions of "Part 2" "Section A" (for ages 36-47 months) of the "Questionnaire" screen are presented in this subsection. This analysis for classifying the performance of each question of "Section A" of the "Questionnaire" screen i.e. of the sensitivity (+ve) and specificity (-ve) of each question of the "Questionnaire" screen has shown questions which were more useful and performed well in identifying deaf children.

The useful questions of "Part 2" "Section A" (For each child) were also classified as follows:

- Questions with high sensitivity and specificity
- Questions with high and medium sensitivity or high and medium specificity
- Questions with high and low sensitivity or high and low specificity
- Questions with medium sensitivity and specificity

These questions of "Section A" (for every child) of the "Questionnaire" screen's are grouped according to their sensitivity (+ve) and specificity (-ve) in identifying deaf children compared with the pure-tone screen (see Table 4.22).

Table 4.22: "Section A" of " Part 2" of the "Questionnaire" screen's (Specific age group of the child aged 36-47 months) performance i.e. sensitive (+ve) and specific (-ve) questions compared with the pure-tone screen results (n=242)

Part 2 'Section A' questions	Pure-tone screen													
	High/high (+ve & -ve) questions: ≥ 90%		High/ medium (+ve & –ve) questions: ≥ 90% & ≥ 50%		High/low (+ve & –ve) questions: ≥90 & <50%		Medium/medium (+ve & -ve) questions: ≥ 50%		Medium/ low (+ve & -ve) questions: ≥ 50% and <50%		Low/low (+ve &-ve) questions: <50%			
	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve		
Q16					3	98								
Q17					5	97								
Q18					5	98								
Q19					93	10								
Q20									20	89				
Q21									46	66				
Q22					8	94								
Q23									27	70				
Q24					97	2								
Q25					2	98								
OB1					3	98								
OB2					2	96								

Notes:

Q=Question, OB=Observation test, --------- this broken line separates the questions (Qs) and the observation tests (OB).

Table 4.22 above shows that the performances of each question (Qs) of the "Questionnaire" screen were classified from high to low. The blank spaces in Table 4.22 signify that no question of the screen fell into these categories. As said before, these blank spaces are kept here to show the categories where these questions are missing.

The results of the performance of "Section A" (specific age group of the child) of the "Questionnaire" screen with 10-questions are summarised as follows: sensitivity = 26%; specificity = 76%; predictive value for positive = 16%; predictive value for negative = 87%; overall = 70%, see Table 4.17. It shows that "Section A" of the "Questionnaire" screen had three questions (Qs: 20, 21 and 23) with medium specificity and low sensitivity in identifying children with >50dBHL across four frequencies (0.5k, 1k, 2k and 4k). "Section A" of "Part 2" of this screen had no questions which were found in the high, high and medium, medium and low sensitive and specific categories.

However, the questions, which identified >80% either with/out hearing loss in excess of 50dBHL in the sample were six out of ten (Qs: 16, 17, 18, 20, 22 and 25) and the two observations OB1 and OB2. Two questions (Qs: 21 and 23) identified 66-70% of the sample correctly see Table 4.17.

The individual questions contained in "Part 2" "Section B" (Age specific of each child), for ages: 48 - 59 months, of the "Questionnaire" screen were classified according to their performance i.e. their sensitivity (+ve) and specificity (-ve) in identifying deaf children compared with the pure-tone screen. These results are presented in the next subsection.

4.1.11 Classification of the performance of "Sections B" of the "Questionnaire" screen for children aged 48-59 months

The analysis and the results for classifying the performance of the questions of "Part 2" "Section B" (for ages 48-59 months) of the "Questionnaire" screen are presented. The results of the performance of 'Part 2' 'Section B' (specific age group of the child) of the "Questionnaire" screen with 10-questions are summarised as follows: sensitivity = 26%; specificity = 76%; predictive value for positive = 12%; predictive value for negative = 92%; overall = 72%. The useful questions of "Part 2" "Section B" (For each child) were also classified as follows:

- Questions with high sensitivity and specificity
- Questions with high and medium sensitivity or high and medium specificity
- Questions with high and low sensitivity or high and low specificity
- Questions with medium sensitivity and specificity

These questions of "Section B" (for every child) of the "Questionnaire" screen are grouped according to their sensitivity (+ve) and specificity (-ve) in identifying deaf children compared with the pure-tone screen see Table 4.23.

Table 4.23: Part 2, 'Section B' of the "Questionnaire" screen (Specific age group of the child aged 48-59 months) i.e. sensitive (+ve) and specific (-ve) questions compared with the pure-tone screen results (n=233)

Questionnaire screen: Part 2 'Section B' questions	Pure-tone screen											
	High/high (+ve & -ve) questions: ≥ 90%		High/ medium (+ve & –ve) questions: ≥ 90% & ≥ 50%		High/low (+ve & –ve) questions: ≥90 & <50%		Medium/medium (+ve & -ve) questions: ≥ 50%		Medium/ low (+ve & -ve) questions: ≥ 50% and <50%		Low/low (+ve &-ve) questions: <50%	
	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve
Q26					3	98						
Q27					10	90						
Q28									72	9		
Q29					17	91						
Q30									14	63		
Q31					91	12						
Q32									11	82		
Q33									32	79		
Q34					18	90						
Q35					18	97						
OB1					2	98						
OB2					28	98						

Notes:

Q=Question, OB=Observation test, --------- this broken line separates the questions (Qs) and the observation tests (OB). The performance of the questions (Qs) of the "Questionnaire" screen was classified from high to low.

Table 4.23 above shows that the performances of each question (Qs) of the "Questionnaire" screen were classified from high to low. The blank spaces in Table 4.23 also signify that no question of the screen fell into these categories. The blank spaces show the categories where the questions were missing.

It shows that "Section B" of the "Questionnaire" screen had six questions and two observations (Qs: 26, 27, 29, 31, 34 and 35; OB1 and OB2), which were evaluated as questions with high, and low sensitivity and specificity. Four questions (Qs: 28, 30, 32 and 33) had medium and low sensitivity and specificity in identifying children with >50dBHL across four frequencies (0.5k, 1k, 2k and 4k). However, six questions and two observation tests (Qs: 26, 27, 29, 32, 34 and 35 plus the two observations: OB1 and OB2) of twelve items of this screen identified >80% either with/out hearing loss in excess of 50dBHL in the sample (n=233).

4.1.12 Classification of the performance of "Section C" of the "Questionnaire" screen for children aged 60-72 months

The analysis and the results for classifying the performance of the questions of "Part 2" "Section C" (for ages 60-72 months) of the "Questionnaire" are presented in this subsection.

These questions of "Part 2" "Section C" (for every child) of the "Questionnaire" screen are grouped according to their sensitivity (+ve) and specificity (-ve) in identifying deaf children compared with the pure-tone screen see Table 4.24 below.

Table 4.24: Part 2, Section C (Specific age group of the child aged 60-72 months) of the performance of the "Questionnaire" screen i.e. sensitive (+ve) and specific (-ve) questions compared with the pure-tone screen results (n=272)

	Pure-tone screen											
"Part 2" "Section C" questions	High/high (+ve & -ve) questions: ≥ 90%		High/ medium (+ve & –ve) questions: ≥ 90% & ≥ 50%		High/low (+ve & –ve) questions: ≥90 & <50%		Medium/ Medium (+ve & -ve) questions: ≥ 50%		Medium/ low (+ve & -ve) questions: ≥ 50% and <50%		Low/low (+ve &-ve) questions: <50%	
	+ve	-ve	+ve	-ve	+ve	-ve	+ve	-ve	-ve	+ve	-ve	+ve
Q36					2	99						
Q37									15	87		
Q38					99	9						
Q39									40	63		
Q40									85	11		
Q41									30	80		
Q42					99	5						
Q43									32	77		
Q44					15	92						
Q45					1	97						
OB1					1	99						
OB2					1	99						

Notes:

Q=Question, OB=Observation test, --------- this broken line separates the questions (Qs) and the observation tests (OB).

Table 4.24 shows that the performances of the questions (Qs) of the "Questionnaire" screen were classified from high to low. The blank spaces in Table 4.24 signify that no question of the screen fell into these categories. These blank spaces are retained to show the categories where these questions are missing. It shows that "Section C" of the "Questionnaire" screen has five questions and two observations (Qs: 36, 38, 42, 44 and 45, OB1 and OB2), which were evaluated as high and low sensitive and specific ones. Five questions (Qs: 37, 39, 40, 41 and 43) had medium and low sensitivity and specificity in identifying children with >50dBL across four frequencies (0.5k, 1k, 2k and 4k). Four questions and two observations were able to identify >80% with and without hearing loss in excess of 50dBL in the sample (Qs: 36, 37, 44 and 45 and observations OB1 and OB2). Three questions (Qs: 39, 41 and 43) identified 63-80% of the sample correctly.

The results of the performance of 'Part 2' 'Section C' (specific age group of the child) of the "Questionnaire" screen with ten questions are summarised as follows: sensitivity = 35%; specificity = 68%; predictive value for positive = 6%; predictive value for negative = 96%; overall = 67%, see Table 4.20. The highly standardised questions of the "Questionnaire" screen brought key information into focus during the interview. This method provided the maximum amount of information in the minimum amount of time. At the end of administering these questions from Part 1 and Part 2 of the "Questionnaire" screen, the interviewer had sufficient information to decide on the hearing status of the child either to pass or fail the screened child. Hearing screening programmes are intended to identify chronic and permanent hearing loss. Screening programmes strive to be efficient and the properly evaluated "Questionnaire" screen of this study demonstrated an acceptable performance for start up programmes where there is no service for deaf children, such as in Binga, Zimbabwe.

The questionnaire screen was evaluated mainly on parameters that are commonly used to evaluate a new tool (protocol), namely:

- Sensitivity: the ability of a new tool to identify the target population accurately (hit rate or number of individuals who actually have hearing loss);
- Specificity: the ability of the new tool/procedure to not identify e.g. to pass those who do not have the hearing loss the screening programme is designed to identify.

4.2 Inter-and intra-user reliability

This section presents the results of the repeat "Questionnaire" and pure-tone screens to evaluate the user variability of this new screen. This is the reliability or the agreement of screens in obtaining similar results on each case tested more than once by the same or a different tester. The test was used to measure the consistence or the agreement of the "Questionnaire" and the pure-tone screen results during repeats. Tables 4.25 – 4.26 present the results of user variability of the "Questionnaire" screen and the pure-tone screen. The next section describes the reliability of the pure-tone screen results obtained from the data collected by the audiologist.

4.2.1 Inter-and intra-user reliability of the pure-tone screen

The data collected by the audiologist was used to test intra-user variability of the pure-tone screening. The results of 110 children who were repeat screened after two-four weeks were compared. Table 4.25 below presents the results of these comparisons.

Table 4.25: The first compared with the second pure-tone screen results per age group (n=110)

Age in months	2nd pure-tone screen	1st pure-tone screen				Total	P-value
		Pass	Difficulty testing	**Fail**	Non co-operating		
36-47	Pass	**25**	-	**2**	-	27	0.01
	Difficulty testing	**4**	6	**1**	-	11	0.01
	Fail	-	-	**2**	-	2	0.01
	Non co-operating	-	-	-	3	3	-
	Total	**29**	**6**	**5**	**3**	**43**	0.01
48-59	Pass	**24**	-	**1**	-	25	-
	Difficulty testing	**1**	-	-	-	1	0.01
	Fail	**2**	-	**3**	1	6	0.03
	Non co-operating	-	-	-	1	1	-
	Total	**27**	-	**4**	**2**	**33**	0.02
60-72	Pass	**27**	-	-	-	27	-
	Difficulty testing	-	-	-	-	-	-
	Fail	**6**	-	**1**	-	7	-
	Non co-operating	-	-	-	-	-	-
	Total	**33**	-	**1**	-	**34**	-
36-72	Pass	**76**	-	**3**	-	79	0.01
	Difficulty testing	**5**	6	**1**	-	12	0.01
	Fail	**8**	-	**6**	1	15	0.01
	Non co-operating	-	-	-	4	4	1.00
	Total	**89**	**6**	**10**	**5**	**110**	0.26

Table 4.25 presents the results of testing the significance of the first and repeat pure-tone screens. There was a high agreement between the first and the repeat pure-tone screens within ages 36-72 months, and 83% (92/110) of the children in the three age groups were identified correctly by the first and the repeat pure-tone screens ($p>0.05$). However, the reliability of the first and repeat pure-tone screens in age groups 36-47 months and 48-59 months showed some disagreements ($p<0.05$).

The agreement of the screens in older children was very high ($p>0.05$). It is clearly shown that the pure-tone results used as gold standard in testing the performance of the "Questionnaire" screen were highly reliable (see Table 4.25). This leads us to test the inter-and intra-user reliability of the "Questionnaire" screen from the data collected by the interviewers, which is presented in the next section.

Table 4.26: The first compared with the second pure-tone screen results per age group for Inter-and-intra-user agreement (n=110)

Age in months	2nd pure-tone screen	1st pure-tone screen				**Inter/intra-user agreement %**
		Pass	Difficulty testing	Fail	Non co-operating	
36-47	Pass	86%	-	-	-	86%
	Difficulty testing	-	100%	-	-	100%
	Fail	-	-	40%	-	40%
	Non co-operating	-	-	-	100%	100%
	Average agreement	**86%**	**100%**	**40%**	**100%**	**82%**
48-59	Pass	89%	-	-	-	89%
	Difficulty testing	-	-	-	-	-
	Fail	-	-	75%	-	75%
	Non co-operating	-	-	-	50%	50%
	Average agreement	**89%**	**-**	**75%**	**50%**	**71%**
60-72	Pass	82%	-	-	-	82%
	Difficulty testing	-	-	-	-	-
	Fail	-	-	100%	-	100%
	Non co-operating	-	-	-	-	-
	Average agreement	**82%**	**-**	**100%**	**-**	**91%**
36-72	Pass	85%	-	-	-	85%
	Difficulty testing	-	100%	-	-	100%
	Fail	-	-	60%	-	60%
	Non co-operating	-	-	-	80%	80%
	Average agreement	**85%**	**100%**	**60%**	**80%**	**83%**

There is a high agreement between the two screening session results. It is established at this stage that the results obtained from the data collected by the audiologist and his assistants who carried out the pure-tone screening were reliable. There was 83% (92/110) agreement between the 1st and 2nd tests as shown in Tables 4.25 and 4.26. In Table 4.27 below the pure-tone testers were compared with each other to establish their individual level of agreements between and within each other (inter-and-intra-user reliability).

Table 4.27: re-user reliability comparisons among pure-tone testers: the first compared with the second screens (n=110)

	First tester (3)		
Second tester	Agree	Disagree	Total
2	28	6	34
3	56	10	66
4	8	2	10
Total	92	18	110

Table 4.27 shows the results of tester 2 who is a teacher of the deaf who helped the audiologist in carrying out the pure-tone screen. There is only one qualified audiologist in the country. Although tester 4 (the author) screened 10 children during the repeat pure-tone screen the purpose for this was for quality checks and control only. He wished to ensure that the audiologist's and his assistant's pure-tone screen results were reliable and valid (see Table 4.27 above). The reliability tests in Table 4.27 show the following re-test agreements:

a) inter-user reliability agreements are as follows;
   - tester 2 compared with tester 3 is 28/34 = 82%
   - tester 4 with tester 3 is 8/10 = 80%

b) intra-user reliability agreements are as follows;
   - tester 3 compared twice i.e. fist and repeat results is 56/66 = 85%

The overall inter-and intra-user reliability between and within testers is 92/110 = 83% see Table 4.26 the summary of the reliability of the pure-tone screen. Table 4.27 clearly shows that there is a high correlation between and within tester results of the pure-tone screen (.83). The pure-tone screen results are reliable and can be used as gold standard to test the performance of the "Questionnaire" screen in identifying permanent hearing loss in the sample group of this study (n=747).

4.2.2 Inter-and intra-user reliability of the "Questionnaire" screen

131 children were retested on the "Questionnaire" screen by two different trained interviewers for inter-and intra-user reliability testing and their results compared. The retest period was two weeks. The agreement of the results obtained from testing the inter- and intra-user reliability of the trained interviewers who used the "Questionnaire" screen is described.

The "Questionnaire" screen was tested for inter and intra-user reliability. Comparisons of the first screen with the repeat (second) screen were done by two fieldworkers: number 1 and number 2 defined in table 3.4 in the methods chapter. These reliability test results are presented in Table 4.28.

Table 4.28: Inter and intra-user reliability of the "Questionnaire" screen, the comparison was done between two "Questionnaire" screeners (tester 1 and 2) i.e. the first screen compared with the second screen (n=131)

Second tester	First tester				Total
	1		2		
	Agree	Disagree	Agree	Disagree	
1	18	2	50	4	74
2	20	5	29	3	57
Total	38	7	79	7	131

Table 4.28 shows that:

a) the inter-user reliability rate of the "Questionnaire" screen was 50/54 = .92

b) the intra-user reliability rates of the "Questionnaire" screen were:

- for tester 1 was 18/20 = .90
- for tester 2 was 29/32 = .90

c) the overall agreement of inter-and intra-user reliability rate of the "Questionnaire" screen was equal to **a** + **b** (50 +18 + 29/54 + 20 + 32 = 117/131) i.e. it is equal to a rate of .89.

It shows that there was an agreement of 89% (117/131) of testers with the same results in both the first and the repeat "Questionnaire" screen in identifying 131 children with indication of hearing loss in five study wards (see Table 4.29 below).

Table 4.29: The 1st versus the 2nd "Questionnaire" screens (n=131)

2nd questionnaire screen:	1st questionnaire screen:		Total	P-value
	Pass	Fail		
Pass	95	7	**102**	
Fail	7	22	**29**	0.07
Total	**102**	**29**	**131**	

Table 4.29 shows that there was a general agreement of 89% (117/131) of children with the same results of the first and repeat "Questionnaire" screen in identifying children with indication of hearing loss in the sample group (n=131) ($p>0.05$). In terms of sensitivity and specificity of the first and repeat "Questionnaire" screen, the results of the agreement are summarised in Table 4.29 above as follows: the "Fail" and "Pass" groups of the first compared with second "Questionnaire" screen were 76% and 93% respectively; the predictive values for "Fail"/"Pass" were 76% and 93% respectively; the overall agreement of the first and the repeat screening results was 89%. This indicates that there was a high correlation between the first and the second interviewers in identifying hearing loss in the sample group of children (n=131). There was a high Kappa coefficient correlation of .89 between screeners.

4.2.3 Concluding primary results

In concluding Part 1 of this chapter, it can be asserted with empirical evidence presented above that these results supported the hypothesis that a questionnaire screen could identify 60-70% of children with permanent hearing loss in excess of 50dBHL averaged across the frequencies' 0.5k, 1k, 2k and 4k of the better ear defined by the pure-tone screen and that non-specific audiology workers can reliably use the "Questionnaire" screen with ease to identify deaf children (see the inter-and intra-user reliability coefficient = .89 in Table 4.29 above).

These primary results of this study show that the overall performance of the "Questionnaire" screen was highly sensitive and specific in identifying hearing-impaired children with a hearing loss in excess of 50dBHL across four selected frequencies of the better ear when compared with the pure-tone screen.

These results are summarised as follows: the sensitivity was 72/91 = 79% and specificity was 504/528 = 96%; the predictive value for positive was 72/96 = 75%; the predictive value for negative was 504/523= 96% and the overall performance was 576/619 = 93% compared with the pure-tone screen ($P>0.05$).

This study also clearly demonstrated that there was a high incidence of hearing loss in the sample group and was estimated at 11% (110/1048 children) i.e. children who failed the pure-tone screen (n=1048).

These findings, clearly confirmed the theory of the mother/father or carer's suspicion about his/her child's hearing problems is usually confirmed by conventional audiometric assessments.

PART B

4.3 Additional results

"Part B" of this chapter presents the additional results of testing the reliability of the "Two-question" recruitment tool in identifying "at-risk" children and evaluating a simple training programme implemented as a way of ensuring provision of appropriate services for deaf children in the study area. The "Two-questions" was used for recruiting subjects of this study. The results are derived from the analysis of data collected by village community workers who used the recruitment tool in identifying the "at-risk" children. The data collected by the recruitment tool were analysed and compared with the questionnaire and the pure-tone screen results. The recruitment tool was used with a belief that it was reliable in identifying at risk children and that about 50% children identified, as at-risk could have a hearing problem. The analysis of data collected by the recruitment tool provides evidence that it can be used for similar studies or for service delivery programmes in developing countries. It has added value for recruiting subjects with low prevalence conditions.

4.3.1 Sample population

The target population of the study was all children aged 36-72 months who lived in the selected five wards of Binga District, namely:

- Sianzyundu (ward 1)
- Lubu (ward 2)
- Muchesu (ward 5)
- Sikalenge (ward 17)
- Nagangala/Sinampande (ward 21)

Table 4.30 shows the sample subjects identified by the Village Community Workers (VCWs) using the "Two-question" recruitment tool in the five study wards during the survey (census) period between May and August 2000.

Table 4.30: Number of children aged 36-72 months identified in the five wards (n=1048)

Ward	No of children	Percent	P-value
1	126	12.1	0.77
4	144	13.7	0.52
5	193	18.4	0.27
17	298	28.4	0.12
21	287	27.4	0.32
Total	**1048**	**100.0**	

Table 4.30 shows that 1048 children aged 36-72 months were identified in the study area.

The number of children identified from each of the selected wards ranged from 126 to 298 with an average of 210 children (see Table 4.30 above). The number of children identified in each ward was similar (p>0.05).

4.3.2 Evaluation of the "Two-question" recruitment tool

The preparatory work was to recruit subjects. The method used to recruit subjects was an innovative "Two-question" recruitment tool as explained in chapter 2. These are the results obtained from the data collected by the "Two-questions" during the recruitment of study subjects as from May to August 2000 in five selected wards of Binga district. Table 4.31 below shows the distribution of the sample subjects of the study.

Table 4.31: Distribution of the sample per age group (age in months)

Age in months	Number of children	Percent	P-value
36-47	337	32.2	
48-59	301	28.7	0.31
60-72	410	39.1	
Total	**1048**	**100.0**	

The average age of children in the study sample was 55 months. Table 4.31 above shows that the age range in the sample group of children was from 36 to 72 months. There were between 301 and 410 children per age group (36-72 month olds). The age distribution of the children in the three age groups was similar (p>0.05).

Table 4.32 presents the sex distribution of children identified in the study area.

Table 4.32: Distribution of the sample per sex

Sex	Number of children	Percent	P-value
Female	532	50.8	0.68
Male	516	49.2	
Total	**1048**	**100.0**	

Table 4.32 shows similar numbers of children in both sexes (p>0.05) identified by village community workers in their respective villages. The further analysis of data collected by the "Two-question" recruitment tool is described in the subsequent subsections.

4.3.3 Evaluation of the "Two-questions"

The recruitment tool that was used to select the subjects of this study had two questions:

- *Question 1: Does the child have difficulties or problems in speaking?*

This question identified 117 (11.2%) children in five wards, whose parents thought they had difficulties in speaking in five wards. These were identified as children at risk and were included as subjects of this study (see Table 4.33 below).

Table 4.33: Responses to a question, difficulties in speaking

Responses		Number of children	Percent	P-value
Difficulties in speaking	Yes	117	11.2	0.0005
	No	931	88.8	
	Total	**1048**	**100.0**	

Table 4.33 shows that village community workers (VCWs) identified a significant number of children (11.25%) aged 36-72 months with difficulties in speaking (p<0.001). However, there was not much difference in cases reported with difficulties in speaking between boys and girls (p>0.05).

- *Question 2: Did the child ever have puss/discharge or other problems with her/his ears?*

Village community workers used this question during the interviews to identify the at-risk children. A significant proportion of children (34.5%) were identified as at-risk (p<0.01). See Table 4.34.

Table 4.34: Responses to the question: did the child ever have pus/discharge or other problems with her/his ears?

Responses		Number of children	Percent	P-value
Ear Diseases	Yes	362	34.5	0.0005
	No	686	65.5	
	Total	**1048**	**100.0**	

34.5% of the children in the target group were reported with a history of pus/discharge or other ear problems. The majority of the children had pus-discharging ears ($p<0.001$). Mothers or carers reported that 62 (17%) of the children reported with a history of pus discharging ears also had speech problems. 62 (53%) children (n=117) had difficulties in speaking (see Table 4.35).

Table 4.35: Responses to the questions: "Does the child have difficulties or problems in speaking?" compared with "Did the child ever have pus/discharge or other problems with her/his ears?"

Pus/discharging ears (Q2)	Difficulties in speaking (Q1)		Total	P-value
	Yes	No		
Yes	62	300	362	0.0001
No	55	631	686	
Total	**117**	**931**	**1048**	

Table 4.35 above summarises the outcomes of the two variables of the two questions compared with each other: sensitivity = 53%; specificity = 68%; predictive value for positive = 17%; predictive value for negative = 92%; overall = 66%; incidence = 11.2%. Children who had a history of ear diseases were not necessarily the same children who had difficulties in speaking ($p<0.001$).

There were 117 children who failed the question (Q1) about difficulties in speaking and 362 children failed the question (Q2) about history of pus discharging ears. There were 62 children who failed both Q1 and Q2. A total number of 417 children failed Q1 or Q2 or both Q1 and Q2 i.e. 362 + 117 - 62 = 417 children. All the 417 children who failed the recruitment tool were enrolled in the study as the "Failing children". These were children at-risk and were included as subjects of this study. This tool did not necessarily identify deaf children but rather children who were at-risk of deafness.

This recruitment methodology was demonstrated to be effective with low prevalence conditions. The study therefore recruited 417 children and registered them in the study as "Failing children". In addition, 417 children were recruited as their controls who were matched age and sex and this next group was registered as the 'Following' children. See Tables 4.36 – 4.37 below.

Table 4.36: Responses to the questions: "Does the child have difficulties or problems in speaking?" compared with "Did the child ever have pus/discharge or other problems with her/his ears?" (n=1048)

		Difficulties in speaking		**Total**	P- value
Sex	Ear Diseases:	Yes	No		
Female	Yes	34	164	198	0.002
	No	26	308	334	
	Total	**60**	**472**	**532**	
Male	Yes	28	136	164	0.004
	No	29	323	352	
	Total	**57**	**459**	**516**	
Total	Yes	62	300	362	0.003
	No	55	631	686	
	Total	**117**	**931**	**1048**	

Table 4.36 shows that ear diseases in both girls ($p<0.01$) and boys ($p<0.01$) were reported (see totals in Table 4.34). Difficulties in speaking was a significant problem in both sexes: girls (n=60) and boys (n=57) and were similar in both sexes ($p<0.01$). In the three age groups (see Table 4.37 below) more children of ages 48-59 months ($p<0.05$) and 60-72 months ($p<0.05$) months were reported with a history of pus/discharging ears than younger children aged 36-47 months ($p>0.05$).

Table 4.37 below shows comparison of responses to "Two-questions": a history of pus/discharging ears or other ear diseases compared with difficulties in speaking (n=1048) in age groups 36-47 months, 48-59 months and 60-72 months respectively. In the younger age group (36-47 months) the mothers or carers reported few cases with a history of pus/discharging ears or other ear diseases and difficulties in speaking ($p>0.05$) compared with other age groups: 48-59 months ($p<0.05$) and 60-72 months ($p<0.05$).

Table 4.37: The two questions: A history of pus/discharging ears or other ear diseases compared with difficulties in speaking (n=1048)

"Did the child ever have pus/discharge or other problems with her/his ears?"		"Does the child have difficulties or problems in speaking?"		**Total**	P-value
		Yes	No		
36-47 month-olds	Yes	17	85	102	0.06
	No	22	213	235	
	Total	**39**	**298**	**337**	
48-59 month-olds	Yes	20	93	113	0.03
	No	16	172	188	
	Total	**36**	**265**	**301**	
60-72 month-olds	Yes	25	122	147	0.04
	No	17	246	263	
	Total	**42**	**368**	**410**	
36-72 month-olds	Yes	62	300	362	0.04
	No	55	631	686	
	Total	**117**	**931**	**1048**	

The statistical tests performed on data contained in Table 4.37 above show that the younger children aged 36-47 months who had a history of ear diseases compared with those who were reported as having difficulties in speaking were similar ($p>0.05$), but within the other age groups, those aged 48-59 months showed a remarkable difference ($p<0.05$) from those aged 60-72 months ($p<0.05$). The proportions of children with difficulties in speaking among the three age groups compared with those who had a history of ear diseases were significantly different in older children of ages 48-72 months ($p<0.05$). In younger children of ages 36-47 months, there were similar proportions between those with difficulties or problems in speaking and those with a history of ear diseases ($p>0.05$).

Generally, there was a significant difference between children with difficulties in speaking compared with children reported with a history of ear diseases in ages 36-72 months ($p<0.05$). There were significant numbers of children who reported with difficulties in speaking in each group. These children were similar in the three age groups.

Part C

4.4 Appropriate services for deaf children

"Part C" presents the follow-up study results obtained from assessing the impact of the intervention of this study. The aim of the assessment was to explore strategies of inclusion of hearing-impaired children in the mainstream activities in rural Zimbabwe. The objective was to assess the knowledge, skills, attitudes and practices (KSAP) of participants trained by the hearing screening programme in the five selected wards.

The follow-up data collection of this study was done 12 months later. The data was collected to assess the effectiveness of a series of training workshops organised and conducted for community and health workers during 2000/2001. The training component of this study was implemented with a purpose of introducing appropriate services for deaf children in Binga. The intervention was meant to fulfil an ethical issue of screening hearing loss in children and complement efforts in existence within the means available for programmes of the deaf in Binga district.

The research question addressed whether a series of 4–5 day training workshops on screening hearing loss and other general issues of hearing-impairment can have an impact on KSAP of service providers in service delivery in the community? It was hypothesised that training can change the professionals' practice of service delivery.

At the end of phase 1 data collection period of 2000/2001, the surveillance register with all the names of deaf children identified by the screen was handed over to the Ministries of Health and Education at Binga offices. The follow up assessment to evaluate the knowledge, skills, attitudes and practices (KSAP) of the trained teachers, health workers and non-governmental organisation workers and the integration of deaf children in local schools in the study location was conducted twelve-months later in 2002

The follow-up study data was collected 12 months later between May and June 2002. It explored knowledge, skills, attitudes and practices (KSAP) of the pre-and primary school teachers, community village workers, rehabilitation technicians and other development workers trained by the study during 2000-2001 period. Comparisons were made between those who were trained against those who were never involved in this study. The children who failed the pure-tone screen were also followed up to ascertain their inclusion at local pre-and primary schools in five former project wards in Binga. This evaluation, therefore served as an assessment of the impact of the fore-mentioned intervention implemented by the Ministries of Health and Education in Binga.

A qualitative assessment to evaluate the impact of the training sessions of this study was carried out. Data were collected on randomly selected focus group and questionnaire subjects. The data was collected between May and June 2002, by fieldworker 2 who was supervised by the author.

The data were collected from the focus group interviews with pre-and primary school teachers, community village workers, rehabilitation technicians and other development workers who were trained and those not previously involved in this study. Self-administered questionnaires were sent to trained and non-involved subjects. Children who failed the pure-tone and questionnaire screens were followed to establish numbers attending local pre-and primary schools.

Focus group discussions were transcribed, coded and analysed. The questionnaire data were entered into Epi-Info 2000 and were also analysed.

4.4.1 Focus group discussion results

After analysing the 7 focus group discussions of both those trained and not trained at 3 workshops during 2000/2001 data collection period, some themes emerged from the closed and open question discussions which are presented in Tables 4.38 – 4.47. Table 4.38 summarises the group responses of the closed questions on the focus guide questions (see the guide questions in Appendix VII).

Table 4.38: Some of the emerged themes on awareness and attitudes towards deaf children from the focus group discussions (n=7)

Themes	Respondents	
	Trained (T)	Untrained (UT)
Awareness of deaf children	Yes	Yes
Things deaf children do:		
1. Similar	Yes	Yes
2. Different	No	No
Sending deaf children to school:	Yes	Yes
1. Regular school	Yes	Yes
2. Special school	No	No
Level of communication:		
1. Superficial	No	Yes
2. Deeper	Yes	Yes

Notes:

T=Trained respondent (attended a training workshop); UT= Untrained respondent (did not attend a training workshop)

Table 4.38 shows that the respondents were aware that there are deaf children in their area,

> "*....yes, deaf children are there in our area*", said by both trained and untrained respondents.

The responses were similar with both trained and untrained groups.

Respondents agree that deaf children do similar things compared with their hearing peers. This was confirmed by both groups, for example,

> "*.... Yes, they do some of the things as hearing children do*", said by T-respondent.
>
> "*...umm, she does some play activities like cooking for each other*" said by UT-respondent.
>
> "*...she does it if she sees others cooking in small tins*", said by UT-respondent
>
> *....she also fetches some water and cooks*", said T-respondent.

Some also reported that deaf children do different things that are normally done by their hearing peers,

> "*....no, they don't do things as others because you will find that s/he is doing different things from what you are doing*", said by UT-respondent.

".....no, they don't do similar things", said by UT-respondent.

There was an agreement among the respondents from both trained and untrained groups that deaf children should be at ordinary schools but some respondents added that there should be a special class established for deaf children at an ordinary school.

All respondents expressed a need of identifying deaf children in their community; these views were strongly expressed by some respondents for example,

> *"....yes, deaf children should be sent to school so that they receive education.....they are supposed to be sent to school because they must learn....they should be enrolled at this same school where their hearing peers are to be able to play together....I was thinking that if it was possible even here, deaf children are all identified, then there be a class of their own and a teacher for them"*, said by the majority of the respondents.

Some respondents also felt a special school was a better place for deaf children to be educated at, this is well illustrated by these responses,

> *"...for some of us, the views that we have, we were thinking that there be a school for those who are deaf...just like there is an exclusive school for blind children"*, said by UT-respondents.

Concerning communication of deaf children with the peer group, siblings, parents and other members of their community, some of the respondents reported that deaf children's communication with these people is at superficial level while others felt it was at deeper level.

The responses were mixed, this is clearly illustrated by the following quotes,

> *"...some of us think it is at a superficial level because at times you are busy playing with the deaf child you communicate only that he understands just like that...no, I don't talk at a deep level since he does not talk...yes, I communicate*

with them at a deep level because these children are also sent on errands like hearing children do", said by the majority of the respondents.

On a question requiring respondents to discuss their perceptions of deafness in their local communities both the trained and untrained respondents listed the possible causes as listed in Table 4.39 below.

Table 4.39: Perceptions of the focus group responses list of causes of deafness in children (n=7)

Perceptual causes of deafness	Quotes
Congenital causes	"..I think at times the problem is in the womb because some have no otitis media but do not hear", said by Untrained (UT). ...some are born deaf", said by Trained (T).
Acquired: diseases	"..it is illness such as measles", said by T. "...for some what causes deafness ...umm is because of the nerves of the ears that are constantly painful", said by UT.
Acquired: accidents	"...then we suspect that when they beat him on the head, maybe they would have beaten him on the nerve of the ear" said by T. "...It is that maybe at birth if the baby is born at home", said by T. "...like these young mothers they may damage the child's head while sleeping", said by UT.
Unknown/God's wish	"...that is how God created him already not hearing", said by UT.

Notes:

T=Trained respondent (attended a training workshop); UT= Untrained respondent (did not attend a training workshop)

Table 4.39 shows that the respondents clearly listed what they thought were main causes of deafness in their community. There was no difference between the trained and untrained groups in producing this list. They are shared views about causes of deafness in the study wards.

The other topic discussed required respondents to come out with what they thought was the prevention of deafness in their community (see the list in Table 4.40).

Table 4.40: Focus group responses on prevention of deafness (n=7)

Perceptual prevention of deafness	**Quotes**
Medical treatment	"...if the child is still young and you discover that he has otitis media you should take the child for treatment because at the hospital there are drugs and injections that can treat it", said by T. "...I think that deafness in children can be prevented by going to the hospital especially the mother if she is pregnant", said by UT.
Regular ear examination	"...yes, these that examine ears, who have been coming here will be examining children", said by T. "...I was thinking that if donors could be found to finance an ear examination and for drugs", said by UT.
Antenatal regular checkups	"...first is to go for antenatal clinics for pregnant mothers to be checked", said by T. "...I think that deafness in children can be prevented by going to the hospital especially the mother during pregnancy", said by UT.
Prayer	"...or that in another way we can pray for his/her ears to be healed", said by UT.

Notes:

T=Trained respondent (attended a training workshop); UT= Untrained respondent (did not attend a training workshop)

Table 4.40 shows that there was an agreement in both trained and untrained groups that deafness should be prevented. The groups both seem to agree on various ways of preventing deafness. The sub-themes that emerged from the discussions are the medical treatment, regular ear examination and antenatal checkups and prayer. The quotes in Table 4.40 clearly illustrate these emerging themes.

The respondents in the seven trained and untrained groups were required to discuss the steps to improve deaf children's welfare. Table 4.41 summarises the themes that emerged from these discussions.

Table 4.41: Focus group responses on steps to improve deaf children's welfare (n=7)

Steps to improve deaf children's welfare	**Quotes**
Education	"... we should encourage parents to send deaf children to school", said by T. "...we can encourage deaf children to go to school, so that they don't stay at home", said by UT.
Public awareness	"... the other thing is to teach people in our areas that whenever they discover that the child is having otitis media they should quickly go to the health centre so that he is treated of this disease", said by T. "....eh the only way which I see which we should do is look for people with knowledge about deaf people, so that they are able to help us", said by UT.
Income generating projects	"...that deaf child also, if there is a school where he is taught practical skills even if he never did well at the academic subjects he can end up having to embark on income generating projects that gives him an income", said by T.

Notes:

T=Trained respondent (attended a training workshop); UT= Untrained respondent (did not attend a training workshop)

Table 4.41 shows that there was an agreement in both trained and untrained groups that there should be steps to improve deaf children's welfare. The groups both seem to agree on various ways of improving their livelihood. The sub-themes that emerged from the discussions are education, public awareness and projects. The quotes in Table 4.41 clearly illustrate these emerging themes. The respondents in the seven trained and untrained groups were required to discuss the steps to improve deaf children's welfare. Table 4.42 below summarises the themes that emerged from these discussions.

Table 4.42: Focus group responses on feelings on discovering that the child is deaf (n=7)

Feelings on discovering that the child is deaf	**Quotes**
Pity	"..so it was a pity, surely deaf children call for pity because at times understanding each other ends up failing", said by T. "...I really feel pity because a child is deaf you may be talking but he can't hear", said by UT.
Pain	"...It is painful to find a young child who does not hear, surely", said T "...if you see a deaf child in the area it pains...", said by UT.
Sorrow	"...I am sorry for the child because he is in difficult circumstances", said T. "...you become sad in that my friend surely gave birth to a lovely but deaf child", UT.

Notes:

T=Trained respondent (attended a training workshop); UT= Untrained respondent (did not attend a training workshop)

Table 4.42 shows that there was an agreement in both trained and untrained groups that they felt pity, pain and sorrow for the deaf child and the family. The groups both seem to agree on various ways of how they usually respond on discovering a deaf child in their community. These sub-themes that emerged from the discussions are illustrated in quotes presented in Table 4.42 above.

The respondents in the seven trained and untrained groups were required to discuss the progress of enrolled deaf children at school or pre-school. Table 4.43 below summarises the themes that emerged from these discussions.

Table 4.43: Focus group responses on progress of enrolled deaf children at pre-and primary school (n=7)

Progress of enrolled deaf children at pre-and primary school	**Quotes**
Positive	"…some deaf children look cleverer than their hearing talking peers", said by T. "…it appeared that she was able because even maths she used to work them out the solutions alone accurately", said by UT.
Negative	"…a notable progress is not there because the child would be far isolated", said by T. "… it appears their progress is not much", said by UT.

Notes:

T=Trained respondent; UT= Untrained respondent

Table 4.43 shows that the respondents disagreed on the fact that deaf children performed equally well, when compared with their hearing peers at school. The trained groups were very positive that deaf children can do better if they are treated accordingly because they are able to work out maths solutions on their own. The untrained groups felt that there is little progress noted on deaf children at local schools. These sub-themes that emerged from the discussions are illustrated in quotes presented in Table 4.43.

The respondents in the seven trained and untrained groups were required to discuss the mode of communication for deaf children in their community. Table 4.44 summarises the themes that emerged from these discussions.

Table 4.44: Focus group responses discussing on the mode of communication for deaf children (n=7)

Mode of communication for deaf children	**Quotes**
Verbal	"…even if you don't raise your voice he will lip-read what you are saying and will understand you", said T. "…at times we bring deaf children nearer and we talk to them ", said UT.
Nonverbal	"…I communicate with him what they call signs", said by UT. "…you talk to her using signs", said by T.
Combine verbal and nonverbal	"…you communicate using signs but at times you teach him verbal communication", said by T. "…if I discover that he does not understand what I am saying, then I use signs and gestures so that we are at the same level of understanding…", said by T. "...communication responses we get are mixed, sometimes there are good responses because we do understand what they are saying to us", said by UT. "…if he understands what you are telling him and he likes it at times he will give a good response, like the one you will have wanted", said by T. "….at times the responses are not appropriate, he responds to what you never said", said by UT. …like myself I find it very difficulty in talking with a person who does not hear ", said by UT.

Notes:

T=Trained respondent; UT= Untrained respondent

Table 4.44 shows that there was an agreement in both trained and untrained groups that the proper way of communicating with deaf children is usually the way in which the child understands better i.e. verbal, nonverbal or combined verbal and nonverbal communication at school and home. The groups both seem to agree on various ways about how they usually communicate with deaf children in their community. The sub-themes that emerged from the discussions are illustrated in quotes presented in Table 4.44.

The respondents in the seven trained and untrained groups were required to discuss the action taken on discovering a deaf child in the community. Table 4.45 summarises the themes that emerged from these discussions.

Table 4.45: Focus group responses discussing the action taken on discovering a deaf child (n=7)

Action taken on discovering a deaf child	Quotes
Refer to clinic/hospital for treatment or rehabilitation	"...at times we refer the child to the rehabilitation department at Binga Hospital for medical treatment and rehabilitation", said by T. "...at times like at my place we try and encourage the mother to try and take the child to the hospital", said by T. "...I did not take any steps", said by UT.
Advise the mother to visit a herbalist	"...as for traditional healers some use oil from bullfrogs while others use oil from the crocodile", said by UT. "...it is good to try both traditional herbalists and the hospital treatments", said by T. "... he does not get well it was worthwhile trying to seek any kind of cure available", said by UT.

Notes:

T=Trained respondent; UT= Untrained respondent

Table 4.45 shows that there was an agreement in both trained and untrained groups that the action taken on discovering a deaf child was to refer the child for treatment and rehabilitation at Binga Hospital and if the child does not get better local herbalists should be tried as well.

The sub-themes that emerged from the discussions are illustrated in quotes presented in Table 4.45 above.

The other unexpected themes that emerged from these discussions were constant danger faced by deaf children and training teachers on issues of teaching deaf children at ordinary schools. These themes are summarised in Table 4.46 below.

Table 4.46: Focus group responses discussing on other emerging issues (n=7)

Other issues	Quotes
Constant danger	"...due to deafness, the child is in constant danger...animals like elephants will kill him.", said by T. "...even with a vehicle if he is walking along the road if he does not look back he will not hear it", said by UT.
Training	"...I would like to say the Ministry of Education should look into the issues of teachers so that they are trained on how to handle such children.", said by UT. "...I just want to give a suggestion that short in-services training for pre-school teachers should be conducted focused on ways of teaching deaf children", said by T.

Notes: T=Trained respondent; UT= Untrained respondent

Table 4.46 shows that there was an agreement in both trained and untrained groups that deaf children are in constant danger in rural areas in Binga where wild animals like elephants co-exist with people in the same environment because they can not hear the danger in advance to avoid it. The respondents suggested that the Ministry of Education should also look into the issue of training pre-school teachers on how to handle deaf children.

These sub-themes that emerged from the discussions are illustrated in quotes presented in Table 4.46. The next subsection presents and describes results obtained from the questionnaires distributed to 22 school heads, 6 health workers and 4 Non-governmental organisation workers (n=32).

4.4.2 Results from the questionnaire responses

The questionnaires sent to 32 subjects were collected and analysed. The results obtained from analysing the following items; importance of enrolling deaf children, children recommended for hearing aids and those children who were actually fitted with hearing aids, are presented in summarised tables below.

Table 4.47 below presents the results of the question: whether it is important to enrol deaf children at an ordinary school.

Table 4.47: Enrolling deaf children at an ordinary school (n=32)

Response	Number			%
	Trained	Untrained	Total	
Very important	14	10	24	75
Not important	0	2	2	6
Does not make any difference	1	3	4	13
Other	1	1	2	6
Total	16	16	32	100

Table 4.47 shows that respondents felt that it was important to enrol deaf children at an ordinary school. Some also have some reservations about this and reported that it does not make any difference enrolling or not enrolling them at ordinary schools.

Table 4.48 presents the results of the question: whether they were aware of organisations deaf children could be referred for further assistance.

Table 4.48: Awareness of organisations deaf children could be referred for further assistance (n=32).

Response	Number			%
	Trained	Untrained	Total	
Yes	13	8	21	66
No	3	8	11	34
Total	16	16	32	100

Table 4.48 shows that 66% (n=21) of the respondents were aware of organisations they could refer deaf children to further investigations and assistance. It also showed that 34% (n=11) of the respondents did not know where else they could refer deaf children for further assistance.

Table 4.49 below presents the results of the question: any child who they recommended for fitting hearing aids?

Table 4.49: Respondents who gave recommendations for fitting a hearing aid (n=32).

Response	Number			%
	Trained	Untrained	Total	
Yes	4	2	6	19
No	11	10	21	66
Don't know	1	4	5	17
Total	16	16	32	100

Table 4.49 shows that 66% (n=21) of the respondents did not recommend any child they identified as deaf for the fitting of a hearing aid. It showed that only 19% (n=6) of the respondents did recommend fitting a hearing aid and about the same number of the respondents didn't know whether they recommended a hearing aid or not.

Table 4.50 presents the results of the question: whose recommendation resulted for any child actually being fitted with a hearing aid?

Table 4.50: Respondents whose recommendation resulted for any deaf child actually fitted with a hearing aid? (n=32).

Response	Number			%
	Trained	Untrained	Total	
Yes	3	1	4	13
No	12	11	23	72
Don't know	1	4	5	15
Total	16	16	32	100

Table 4.50 shows that 72% (n=23) of children who were recommended for fitting of a hearing aid didn't get one fitted. It showed that only 13% (n=4) of children who were recommended for fitting a hearing aid got one fitted.

The subsequent sections lead us to the results obtained from observing deaf children enrolled at 4 selected schools in the study wards, which was done by a specialist trained teacher of the deaf to try and assess the impact of integrating deaf children at an ordinary school.

4.4.3 Results of observations conducted on enrolled deaf children at local schools

There were 110 children who failed the pure-tone screen aged between 36 and 72 months. There were 6 children aged 72 months who failed the screen in 2000/2001 who were assessed for school replacement (n=6) for school term beginning January 2002 at four randomly selected primary schools in the study wards. These children were recorded and their activities were observed and rated by a trained interviewer.

Table 4.51 presents the number of deaf children aged 72 months enrolled and attending local schools.

Table 4.51: Number of children aged 72 months identified as deaf (n=6) by pure-tone screen in 3 study wards covered by 4 ordinary schools compared with actually enrolled deaf children (n=12)

Primary school	Number of children enrolled
Lubu	3
Manjolo Springs	7
Nagangala	1
Sinampande	1
Total	12

Table 4.51 shows that all 6 children assessed for school placement in 2000-2001 data collection period were enrolled at local schools. The professionals also identified 6 older children who were not previously identified in the 2000-2001 screening period. Deaf children of school going age identified in 3 wards were all enrolled at local schools.

Table 4.52 below presents the activities and ratings given to the integrated deaf children in selected variables.

Table 4.52: Performance of deaf enrolled children at an ordinary school

Activity	Rating
School attendance	Excellent
Involvement in group work	Good
Play time involvement	Excellent
Involvement in school games	Excellent
General social interaction	Good

Table 4.52 shows that the involvement of the enrolled deaf children at local schools was satisfactorily rated between good and excellent at both school curriculum and extramural activities.

In conclusion it can be asserted that the results presented and described in this chapter confirmed our hypothesis that the "Questionnaire" screen can be used by non specialist trained audiology workers reliably, in identifying permanent hearing loss in children aged 36-72 months in Binga district. The screen is low cost and can also be adapted to suit cultural differences in rural Zimbabwe or other developing countries where there are no high-technological audiology tests.

A discussion of the main findings of this study and related issues on screening hearing loss in young children in Zimbabwe are synthesised in chapter 5 of this thesis. The next chapter brings together the proponents of chapters 2 and 4 discussing the current thinking in screening permanent hearing loss in young children in developing countries. It concludes by recommending what future researchers in this field have to look into to improve the performance of low cost hearing screens to identify permanent hearing loss in young children in developing countries. The discussion of the main findings of this study is dealt with in the next chapter.

CHAPTER 5

DISCUSSION

CHAPTER 5

5.0 Discussion

This chapter discusses how the main findings support or do not support the original hypothesis, and whether they agree with the findings of other researchers in screening permanent hearing loss in children using questionnaire screens. The following issues are discussed:

- "Questionnaire" screen compared with the pure-tone screen
- "Questionnaire" screen compared with the repeat "Questionnaire" screen
- Pure-tone screen compared with the repeat pure-tone screen
- Perceived need to screen hearing loss in children
- Cultural constructs of hearing loss
- Appropriate services for deaf children
- Implication of the study

Explanations for the findings and limitations of the study that restrict the extent to which the findings can be generalised are discussed. The chapter concludes by discussing the implications of screening hearing loss in young children. The discussion is chronologically ordered in subsequent sections.

5.1 "Questionnaire" screen compared with pure-tone screen

Statistical analysis showed similar performance of the "Questionnaire" screen compared with gold standard of the pure-tone screen in identifying bilateral hearing loss in excess of 50dBHL of the better ear averaged across four frequencies: 0.5k, 1k, 2k and 4k. Both screening protocols identified 14-15% children as having bilateral hearing loss. These findings showed that the "Questionnaire" screen identified 15% (115) children ($p<0.001$) of the study sample ($n=747$) while the pure-tone screen identified 111 (14%) children ($p<0.001$) as having bilateral hearing loss in excess of 50dBHL of the better ear averaged across four frequencies: 0.5k, 1k, 2k, and 4k of the study sample ($n=747$). In addition it is important to emphasize that subjects who were screened by these protocols were similar in five wards in the three age groups ($p>0.05$).

It was hypothesised that the "Questionnaire" screen identifies 60% of sensorineural hearing impairment in children compared with the pure-tone audiometric screening. The performance of the "Questionnaire" screen was higher than our hypothesis because it identified 79.8% of children with hearing loss in excess of 50dBHL in four selected frequencies of the better ear. Although the Kamplex screening audiometer did not have the facility for testing bone conduction to ascertain true cases of sensorineural hearing loss, I can still infer that the "Questionnaire" screen can correctly identify permanent bilateral hearing loss (sensorineural) in children aged 36-72 months correctly compared with the pure-tone screen. There is clear evidence after comparing the repeat "Questionnaire" screen with the pure-tone screen that it is valid and reliable in screening hearing loss in young children. For example, they were 110 against 115 children who failed the pure-tone screen compared with the "Questionnaire" screen. These subjects were similar in the study area in three age groups ($p>0.05$). The statistical tests results show clear evidence that the "Questionnaire" screen compared with the pure-tone screen identified the same children aged 36-72 months ($p>0.05$) as having failed both screens. These results broken down per age group showed that both protocols performed similarly in identifying deaf children ($p>0.05$).

The repeat tests of both screens showed similar results as stated earlier ($n=110$). These findings lead us to believe that there is no significant difference in the performance of the "Questionnaire" screen compared with the pure-tone screen ($p>0.05$) in identifying permanent bilateral hearing loss in children.

Only in "Ward 4" did we recognise a unique trend during the repeat screen, where the "Questionnaire" screen performed comparatively lower in identifying deaf children, than was the case in the other four wards ($p<0.05$). This observation cannot be easily explained. I am left to speculate reasons for this difference observed, one possible explanation is the high level of fear instilled during the parliamentary elections suggesting that mothers or carers might have been intimidated by the presence of the screening team members who were strangers in the area. The mothers or carers could have been suspicious of the interviewer's questions and would answer what they thought was what the interviewer wanted to know and was safe for them. Another reason could be that the mothers or carers provided the most convenient answers they thought were deemed right because of their familiarity with the questions from the first screen. Or it might be partly explained by the fact that a different carer was interviewed the second time. However, the reasons for such differences are not apparent and not easily explained by the study. The performances of the repeat "Questionnaire" screen per age group (n=131) were similar and consistent with the overall results of the first screens (n=747) ($p>0.05$).

In addition to the statistical test results discussed above, when the sensitivity and the specificity of the "Questionnaire" screen were considered, these results show that the performance of this screen was very high in identifying deaf children. The sensitivity and the specificity were as high as 79.8% and 96% respectively, the predictive values for positive and negative were 75% and 92% respectively and the overall performance of the screen was 96% in identifying children with and without hearing loss. These findings are of considerable importance since the "Questionnaire" screen's performance was overall rated very high at 96%. This implied that only 4% of the total sample was misclassified by the "Questionnaire" screen in the sample population (n=747). This means that the screen identified about 96% of the sample population with or without moderate to severe bilateral sensorineural and conductive hearing loss correctly compared with the pure-tone screen. From these results, it can be stated that the optimal level of performance of the "Questionnaire screen can be tempered with and improved by studying the performance of the single items contained in the "Questionnaire" screen and refine the screen further by excluding less useful bits of the questions from the screen to increase the sensitivity without lowering the specificity as it stands at 96% in identifying higher hearing threshold levels of <40dBHL which is a significant impairment level which this study was not able to assess.

I acknowledge that the way the study was designed it is not able to determine the performance of the "Questionnaire" screen in detecting mild cases of temporary hearing loss due to the fact that the pure-tone screen cut-off hearing threshold level was lowered to 50dBHL.

However a possible explanation of a medium sensitivity of the "Questionnaire" screen to detect mild and moderate cases of temporary hearing loss is partly due to the fact that the prevalence rate of sensorineural hearing loss is very low and as said before is estimated at 0.4-2 per 1000 live births (Mauk et al. 1991). The overall performance outcome of the "Questionnaire" screen shows that the screen is valid and reliable. The screen can be used to identify deaf children in rural Zimbabwe.

This study offers clear evidence that the "Questionnaire" screen had high performances in all age groups, the least being observed in the 48-59 months age range summarised as follows:

- 36-47 month-olds; 89% and 99% sensitivity and specificity respectively
- 48-59 month-olds; 75% and 96% sensitivity and specificity respectively
- 60-72 month-olds; 77% and 93% sensitivity and specificity respectively

The "Questionnaire" screen's sensitivity in children of ages 48-59 months was lower compared with the sensitivity in children of ages 36-47 months. It is unusual for behavioural screening tests to perform higher in younger children than in older ones as being observed in this study. I cannot easily find a good explanation but infer that the gold standard pure-tone screen is weaker in younger children. This could possibly be the main reason for the higher performance of the "Questionnaire" screen in younger children than in older ones because I am comparing with weaker gold standard results. The true sensitivity of the "Questionnaire" screen may lie between 75% and 80%. I also believe the majority of children identified by the pure-tone screen were cases of temporary conductive hearing loss because of a high prevalence of pus discharging ears noticed which usually clears itself within 6-8 weeks and has no remarkable effects on verbal communication hence about 20% of deaf children in the sample size were missed by the "Questionnaire" screen. Otherwise, the performance of the "Questionnaire" screen was similar ($p>0.05$) and identified children with hearing impairment as compared with the pure-tone screen in Binga. Clearly, the "Questionnaire" screen showed that it is valid and reliable as a tool in identifying sensorineural hearing loss in young children in rural Zimbabwe.

The reliability of the "Questionnaire" screen is of paramount importance since it suggests that the inter-and intra-user reliability has to be equally discussed when determining the ease of use by non-specific audiology community workers in using this screen. However the discussion of this issue of testing inter-and-intra-user reliability is in the next sub-section.

Validity of study instruments

This research attempted to assess the user variability of the study instruments towards their consistency in getting similar results when repeated several times on the same subject. The assumption here is that the condition measured is static which is the case with permanent (sensorineural) bilateral hearing loss in children. I originally hypothesised that workers with only minimal audiology training could easily use the "Questionnaire" screen and produce highly correlated results. The question of reliability of the "Questionnaire" screen is discussed by comparing the repeat "Questionnaire" screen and the pure-tone screen to test their inter-and intra-user reliability.

The measurement of reliability of the screen obtains similar results on each case tested more than once by the same or a different tester. This measure was used to test inter-and intra-user reliability of the "Questionnaire" screen and also for validating the results of the pure-tone screen.

Validity of the pure-tone screen results

The validity tests were performed on 110 children who had the pure-tone repeat screen and the results compared with those of the first pure-tone screen which established the audiologist's (the only fully qualified audiologist in Zimbabwe) and two audiologically aware staff's (one teacher of the deaf and one researcher with some audiological training) accuracy in determining a case as opposed to non-cases of hearing loss (n=110). The results were in substantial agreement with those of the first screen: the consistency of the first and the repeat results in children tested twice with hearing loss were 83% and 85% for inter-user and intra-user respectively; the overall agreement of the first and second pure-tone screen results in identifying children with and without hearing loss in the sample group was 83%. There is a high agreement between the two screening session results. It appears that the screens reliably produced similar results within a period of two weeks interval from the initial screen.

In this instance, it is established that the results obtained from the data collected by the audiologist and his assistants (one teacher of the deaf and one researcher with some audiological training) who carried out the pure-tone screening were reliable ($r=0.82$) and the agreement between the 1st and 2nd tests was very high. The first and repeat pure-tone screen results were valid ($p>0.05$).

However, the reliability of the first and repeat pure-tone screens in ages 36-47 months and 48-59 months showed some disagreements ($p<0.05$). The agreement of the screens in older children was very high ($p>0.05$). The limitations in the pure-tone screen in younger children not withstanding this study, suggests that the pure-tone in this age group is weaker as a gold standard measure to test the performance of a new screen. This could also be a possible explanation for a high sensitivity of the "Questionnaire" screen in this study in the younger children.

Reliability of the "Questionnaire" screen

The study originally hypothesised that the reliability of the "Questionnaire" screen when used by the same or another person repeatedly would be highly correlated. For reliability testing, one hundred and thirty-one (n=131) children who were repeat screened after two-weeks showed similar results compared with the first screen. There was a high level of agreement ($r=0.89$) between the first and the repeat questionnaire screen in identifying the same children (117) in the sample (n=131) with indication of hearing loss in five study wards ($p>0.05$).

Although, the overall agreement of the results of the "Questionnaire" screens was very high in five wards, there were some discrepancies observed in the three wards (4, 17 and 21) between the first and repeat questionnaire screen results ($p<0.05$). The "Questionnaire" screen was highly correlated with Kappa coefficient of 0.89 and was comparably similar with the Kappa correlation coefficient of 0.83 with the pure-tone screen ($p>0.05$). It seems clear that the "Questionnaire" screen usually picks permanent or chronic cases of hearing loss, which do not change over a short interval of time, while the pure-tone screen could also possibly pick cases of temporary hearing loss in children due to otitis media. The "Questionnaire" screen has promise as a tool in screening hearing loss in children in rural Zimbabwe. Interviewers with less specific audiological training can easily and reliably use the screen.

I also acknowledge that the questions contained in this screen do not detect hearing loss at a similar performance level and some of the questions of the "Questionnaire" screen are less useful and need to be excluded after a careful scrutiny of the sensitivity and the specificity of each question.

Sensitivity and specificity of the questions of the "Questionnaire" screen

It was initial believed that all 18 questions for each child were equally important to screen children for hearing loss. The results of this study, however, go against our theory. A few questions had high sensitivity and specificity, a reasonable number had moderate sensitivity and specificity and some questions performed poorly on this aspect.

The findings show that there was no question of "Part 1" with a sensitivity of >70%. Question eight (Q8) had a sensitivity of between 50 and 70%; questions 9, 14 and 15 (Qs; 9, 14 and 15) had sensitivity of between 30 and 49% and questions 10, 11, 12 and 13 (Qs; 10, 11, 12 and 13) had sensitivity of <30%. However, all questions had a specificity of >70%. "Part 1" has mixed performance questions in identifying hearing loss in children. The overall performance of "Part 1" questions was high and identified >77% children with and without hearing loss in a sample group of 747 children but there was one question (Q14) that had an overall performance of 68% (see Table 4.17).

“Part 1” questions of the "Questionnaire" screen generally performed moderately well in identifying 747 children with and without moderate hearing loss ($\geq$50dBHL) in four frequencies: 0.5k, 1k, 2k and 4k. These findings thus lend support for the need to refine the “Questionnaire” screen further to include only four questions: 8, 9, 14 and 15 plus bio-data questions 1-7 and exclude the remaining poor performing questions of “Part 1” of this screen.

The findings of the performance of “Section A” of “Part 2” against the pure-tone screen show that there were two questions (Q; 19 and 24) of “Section A” with a sensitivity of >70%. It is regrettably noticed that no question in this section performed moderately well in the sensitivity range of 50-70%. However question 21 had sensitivity of between 30 and 49% and the rest of the questions (Qs; 16, 17, 18, 20,22, 23 and 25 plus two observation tests OB1 and OB2) had sensitivity of <30%. It was surprisingly noted that all the poorly sensitive questions had a specificity of> 70-%) and highly sensitive questions (Qs; 19 and 24) had very poor specificity of less that 10%. “Section A” of “Part 2” has a mixture of questions with high and low sensitivity and specificity.

When considering the overall performance of each question it is striking to note that eight questions (Qs: 16, 17, 18, 20, 22 and 25 plus two observation tests OB1 and OB2) of this section identified >77% of the children with and without hearing loss in a sample group (n=747), two questions (Qs; 21 and 23) identified 63-80% and the other two questions (Qs; 19 and 24) identified <20% of the children correctly. It can be asserted that “Part 2” “Section A” questions of the “Questionnaire” screen had high specificity in identifying deaf children.

These results are mixed and pose big problems in selecting the best mix of the questions that could be included in the recommended refined “Questionnaire” screen. One approach of looking into this might be to take the very high performers overall or a mixture of questions with high and low sensitivity and specificity. Whatever approach is taken has a trade-off effect which can only be tested in the field.

The questions in "Section A" of the "Questionnaire" screen of this study have many shortcomings, but it seems to demonstrate that it is difficult to screen the 36 to 47 months age group using the pure-tone screen as a gold standard. There are problems of selecting appropriate reliable tests for the 36 to 47 month olds because some of these children are not developmentally mature enough for the pure-tone audiometry. Because of the problems of the reference tests of the pure-tone screen in this age group, the performance of "Section A" of this "Questionnaire" cannot be definitely tied to the definitions imposed by the pure-tone screen as reference tests.

Despite the problems of the reference tests in the younger children it can be asserted that the "Questionnaire" screen is valid and reliable when considering the high reliability Kappa coefficients of 0.89 and 0.83 between testers of the "Questionnaire" screen and the pure-tone screen to confirm the validity and the reliability of the screen results. I am bearing in mind that the reliability of the pure-tone screen was relatively moderate in the failing group of the 36-47 month-olds (40%) compared to the other age groups i.e. 48-59 months (75%) and 60-72 months (100%) respectively (see Table 4.27). Screening of this age group conforms to the concept based on a behavioural psychology approach that could lead to new important findings about screening young children. However I suggest that the refinement of the "Questionnaire" screen could include questions: 19, 21, 23 and 24 plus the observation instructions 1 and 2 and leave out the remainder.

The performance of each question in "Section B" of the "Questionnaire" screen compared with the pure-tone screen showed mixed results (see Table 4.19). There were two questions (Qs: 28 and 31) with a high sensitivity of >70%, one question (Q33) had a marginal moderate sensitivity of between 30 and 49% while seven questions (Qs: 26, 27, 29, 30, 32, 34 and 35) had a low sensitivity of <30%. Seven questions (Qs: 26, 27, 29, 30, 32, 34 and 35) had high specificity. Only two questions (Qs: 28 and 31) had very low specificity. The two observation tests (OB1 and OB2) had high specificity. Ten questions and two observations of "Section B" of Part 2 (Qs: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, OB1 and OB2) of the "Questionnaire" screen identified 72% children with and without hearing loss in a sample group of 233 children. These mixed results support the view that only a few valid questions are needed to make up a reliable and a valid hearing screen. This suggests that about 4-5 questions could be retained here and the majority of poor performing ones should be excluded. The following questions (Qs): 26, 27, 28, 31 and 32 plus the two observation instructions: 1 and 2 can be included in the refined "Questionnaire" screen (see Table 5.1).

The results of the performance of "Section C" of "Part 2" of the "Questionnaire" screen compared with the pure-tone screen show that three questions (Qs: 38, 40 and 42) in this section had a sensitivity of >70%. None of the questions had a sensitivity of 50-70%, but three questions (Qs: 39, 41 and 43) had a sensitivity of between 30 and 49%. Four questions and two observation instructions (Qs; 36,3 7, 44, 45, OB1 and OB2) had a sensitivity of <30% and six questions and two observation instructions (Qs: 36, 37, 41, 43, 44, 45, OB1 and OB2) had a specificity of >77%. "Section C" of "Part 2" had a mixture of questions with high or low sensitivity and high or low specificity. These results provide evidence that only a few valid questions need to be retained in this section. The valid questions according to these results that might need to be included in a refined version of the "Questionnaire" screen could include the following questions: 36, 37, 38, 40 and 42 plus the two observation instructions: 1 and 2 (see Table 5.1).

The scale on the summary sheet of the "Questionnaire" screen was graded from 0 to 10 (0 being no response to sound and 10 meant the child responded always) and shows the performance of the observations scale:

- ≥4 scale was: sensitivity and specificity of 17% and 93% respectively; predictive values for positive and negative of 8% and 92% respectively and the overall performance of this measurement on scale was 77%
- <4 scale was: sensitivity and specificity of 1% and 99% respectively; predictive values for positive and negative of 8% and 94% respectively. The overall of this measurement on the scale was 90%

The observation scale implies that it can exclude most false positive cases, hence is highly specific in detecting 99% children without hearing loss in excess of 50dBHL across four frequencies. Even if it is such an important item of this screen it excludes the majority of cases of hearing loss and should not be entirely relied upon to decide the cases for further investigations. I suggest the scale could be retained in the further refinement of this screen. Table 5.1 below shows the summary of questions that were evaluated with a high or medium sensitivity and specificity in screening hearing loss in children aged 36-72 months in rural Zimbabwe.

Table 5.1: Summary of the questions (Q) and observations tests (OB) evaluated with a high and medium sensitivity or with a high and medium specificity that can be included in the refined "Questionnaire" screen plus bio-data questions 1 to 7 of "Part 1" of the screen.

"Part 1" General questions (for each child)	"Part 2" Age specific questions		
	"Section A" for ages 36-47 months	"Section B" for ages 48-59 months	"Section C" for ages 60-72 months
Q8	Q19	Q28	Q38
Q9	Q21	Q31	Q39
Q14	Q23	Q33	Q40
Q15	Q24	Q34	Q42
-	OB1	OB1	OB1
-	OB2	OB2	OB2

Table 5.1 shows that there are few questions with high and medium sensitivity and specificity that might be included for the future "Questionnaire" screens for research or service delivery programmes in Sub-Saharan Africa (see Table 5.1 and Appendix XVIII).

There is clear evidence that this study made the administration of the "Questionnaire" screen very easy by providing interviewers with a simple standardised procedure. The questions of the "Questionnaire" screen were asked in a most efficient way to detect hearing impairment in the target group. The "Questionnaire" screen had only closed questions that required "Yes" and "No" responses. Direct, highly specific and briefly stated questions brought key information into focus as the evaluation progressed. This method collected the required amount of information in the minimum amount of time. At the end of administering the questions of "Part 1" and "Part 2" of the screen, the interviewer had sufficient information to decide on the hearing status of the child to either pass or fail the screened child.

I acknowledge that developing a reliable and valid "Questionnaire" screen to identify chronic and permanent hearing loss in young children is not adequate until this effort is accompanied by reliably funded hearing screening and rehabilitation programmes. Such screening programmes should strive to be efficient and properly monitored and evaluated. In fact the "Questionnaire" screen developed and tested in the field by this study demonstrated an acceptable performance for start up programmes in areas where there are no services for deaf children such as in Binga, Zimbabwe.

The "Questionnaire" screen was evaluated mainly on parameters that are commonly accepted and used to evaluate a new tool (protocol) namely:

- Sensitivity: the ability of a new tool to identify the target population accurately (hit rate or number of individuals who actually have hearing loss.
- Specificity: the ability of the new tool procedure to not identify (e.g. to pass) those who do not have the hearing loss the screening programme is designed to identify.

In addition the performance of the "Questionnaire" screen was rigorously subjected to Chi-square (X^2) for statistical significance tests when compared with the pure-tone screen. These results provide clear evidence that the "Questionnaire" screen has promise as a tool in identifying sensorineural hearing loss in rural Zimbabwe. These findings are of considerable importance since it suggests that the community rehabilitation workers in rural areas could easily use it and the identified deaf children referred for either medical and or educational rehabilitation within their local institutions.

5.2 Perceived need to screen hearing loss in children

This study provided evidence that screening hearing loss in young children in rural Zimbabwe meets a need in the community. In the first instance the "Two-question" recruitment tool identified 417 at-risk children (n=1048). The "Questionnaire" screen then identified 72 deaf children correctly from the 110 identified by the pure-tone screen ($p>0.05$). The pure-tone screen identified 11% (n=110) of the sample population (n=1048) initially identified by the "Two-question" recruitment tool of all children aged 36-72 months in the selected five wards. The number of mothers or carers reporting that their children had pus discharging ears and the actual numbers of children who were referred to clinics and Binga Hospital was alarmingly high and more than 300 children were treated for otitis media. Furthermore the results of this study show us the extent of the problem of hearing loss in children in Binga district. There were similar numbers of children who failed the pure-tone screen in five study wards ($p>0.05$). The "Questionnaire" screen also identified (15.7%) 117 of the children (n=747) as having failed the screen.

The "Questionnaire" screen's performance compared with the pure-tone screen in identifying deaf children was statistically similar ($p>0.05$). This finding can be explained by the fact that poor regions have a high incidence of pus discharging ears in young children which is a cause of temporary conductive hearing loss in children and the mothers or carers intuitively respond to their children's hearing problems. As mentioned earlier, mothers or carers are usually worried about their children not speaking. The "Two-question" recruitment tool and the "Questionnaire" screen results, which showed that they captured cases of suspected hearing loss that mainly also had some bearing on problems in speaking, support this fact. It was also realised that chronic cases of otitis media had remarkable problems in speaking (n=62) out of 632 children who were reported by their mothers or carers to have had a history of ear diseases. I suspect these children (n=62) were mainly cases of chronic or permanent hearing impairment.

The performance of the "Questionnaire" screen did not change much even when compared with the repeat pure-tone screen results. This shows the consistency of the performance of these tools in identifying children who present high risk factors of hearing impairment ($p>0.05$) compared with the pure-tone screen. I acknowledge that the recruitment tool and the "Questionnaire" screen underestimated the extent of the problem of hearing loss in Binga district.

Despite these methodological problems it is clear that the prevalence of hearing loss in children when cases of otitis media are included could be higher than 11% in pre-school age group. These results are consistent with previous research (Brown and Hanlon, 2002; Bethune, 2002). Bethune's (2002) study stated that up to 9 out of 10 aboriginal babies might have hearing loss associated with otitis media in the Northern Territory of Australia. Research on remote communities in the Northern Territory, Australia and Maori communities in New Zealand indicates up to 100% of babies have perforated eardrums during the first year of life, and 30-80% of the Aboriginal school age children have conductive hearing loss. In most Aboriginal communities in Australia chronic otitis media is prevalent at levels considered by the WHO to represent major health problems (Bethune, 2002). These results confirmed the need to screen hearing loss in Binga (McPherson and Swart, 1997; Jones, 1974; WHO, 1998, Binga Hospital, 2001).

The estimate of hearing loss in Zimbabwe is about 6 to 8%, hence, I was not expecting to find such a high incidence (11%) of hearing loss in children aged between 36 and 72 months in Binga. This revelation, therefore, requires a discussion on the prevalence of hearing loss in young children in the study wards of Binga district.

Prevalence of hearing loss in children aged 36-72months in the study wards

In literature it was estimated that about 6-8% of children aged 36-72 months in Binga could be deaf. The pure-tone screen confirmed an overall incidence of hearing loss of about 11% ($p<0.001$) in excess of 50dBHL averaged across four frequencies (0.5k, 1k, 2k and 4k) in the sample ($n=747$). There were some minor variations in cases identified by the "Questionnaire" screen and the pure-tone screen in different wards but not significant enough to pose problems in our estimations ($p>0.05$).

Despite these variations the point prevalence (incidence) of hearing loss in Binga as shown by this study is similar with prevalence rates reported by various studies in Sub-Saharan Africa (Hatcher et al. 1995; Chege, 2000; White, 1988). Some studies reporting prevalence rates of hearing impairment in children in developing countries show widely varying estimates. For example, Al-Muhaimeed (1996) reported a community-based study in Saudi Arabia where 39% hearing impairment prevalence rates were reported, in the "at-risk children but most of the hearing impairment cases are found to be conductive and mild, and caused by secretory otitis media" (Al-Muhaimeed, 1996; Selly et al. 1995; Little et al. 1992; Hatcher et al. 1995; Chege, 2000; White, 1988). It appears that the reported various estimates of hearing loss in children reflect the variety of methodologies used such as:

i. Screening procedures
ii. Intensity levels at which screening levels are set
iii. Focus of the screen, i.e. impairment, pathology or disability
iv. Skill and experience of the tester
v. Ambient noise levels
vi. Number of difficult children to test not reported

I acknowledge that our estimates of 11% hearing loss in children aged 36-72 months in Binga according to this study is similar to other community-based studies on this topic in developing countries.

This study confirms earlier findings that prevalence of hearing loss in children in rural areas is higher compared to urban settings (Jones, 1974). There are various reasons attributing to a high prevalence in economically poor areas such as Binga District, one being the high incidence and severity of medical conditions such as measles and meningitis known to be associated with impaired hearing, this therefore supporting the likelihood that hearing impairment is more prevalent in developing than developed countries (Woodrow, 1997). Haggard and Hughes (1991) argue that this might in part be due to undetected and untreated ear disease, as well as too late identification of mild and moderate hearing loss beyond the age where appropriate early amplification can prevent the development of permanent disability. I am not sure how to explain these results because we expected significantly lower prevalence rates between 2 and 8% (Jones 1974). Home-based studies are lacking and consequently less is known about children with milder hearing impairment in Zimbabwe.

Based on both my experience and the data gathered in Binga district, a substantial proportion of children with moderate to profound hearing impairment were not identified early enough and diagnosed at a sufficiently early age to benefit fully from intervention services so as to minimise delays in the acquisition of speech, language and communication skills. If early intervention were implemented it could possibly reduce the occurrence of other disabilities associated with hearing impairment.

These findings probably underestimated the actual magnitude of delay in diagnosis. Specifically, while the prevalence of hearing impairment in the study area is very high compared with the national rates as reported by other population-based studies using similar definitions of hearing loss of >50dBHL averaged across four frequencies: 0.5k; 1k, 2k and 4k (Binga, 2001), this study did not attempt to identify degrees of hearing loss of <50dBHL. If a cut-off point of bilateral <50dBHL was used in this study higher prevalence rates in the total population could have been reported (Kankkunen, 1982; Sorri and Tantakallio, 1985). Although losses of 25-30dBHL and greater are considered interfering with the development of communication skills even if the loss is unilateral (Mauk et al., 1991), it can be argued that few studies have demonstrated the efficacy and cost benefits of programmes enrolling such cases in rural Zimbabwe.

Since a universal screening protocol in rural areas of Zimbabwe is not appropriate for reasons of scarce resources, I can however recommend that a selective screening programme, for example, of pre-and primary school entry and children with difficulties in speaking and chronic ear diseases or other risk factors be done in rural areas. The risk factors could be looked in context of endemic problems usually observed by each country or area. Such examples could be drawn from experiences gained from developed countries e.g. the USA and the UK (Mauk et al. 1991) where audiologic screening is recommended for infants with one or more specific risk factors:

- A birth-weight less than 1500g,
- Bacterial meningitis, and
- Anatomic malformation of the ear

It can be argued that the above list is inadequate because Mauk et al.'s (1991) study shows that one or more of these risk factors were present in only 50% of all children among whom substantial hearing impairment was eventually diagnosed (Mauk et al. 1991). Although there is no empirical evidence about the age for the identification of deafness, it appears that the mean age at diagnosis for children with sensorineural hearing impairment in Zimbabwe is after five years. Late identification of hearing-impaired children is a normal occurrence in Binga as observed during the field period of this study.

Mothers and carers usually seek cure or help from professionals such as pre-and primary school teachers and health workers who in most cases have nothing to offer since they are not well trained to screen hearing loss in children. The findings of this study emphasise the public health opportunity for the early identification of and appropriate intervention for children with hearing-impairment and the need for the development and evaluation of routine low cost hearing screening programmes in rural areas in Zimbabwe.

Despite the fact that the study underestimated the prevalence of hearing loss in the target group, the community in Binga perceives hearing loss as a real problem. This study therefore enables us to estimate the prevalence of hearing loss in our target group at about 11%, which as said before is comparable with other studies from similar socio-economic disadvantaged communities (Bethune, 2002; Brown and Hanlon, 2002).

5.3 Cultural constructs of hearing loss in Binga

Clearly the study has raised an important dimension in the sense that successful outputs from any programme will require an intrinsic understanding of culture and experience with respect to disability. The simplest definition of a disabled person is one who is regarded in his society as disabled because of differences in appearance or behaviour (Helander, 1992). Therefore, programme implementation that both meets needs of disabled people and protects their human rights must be built on the understanding of local beliefs and attitudes. Communities are not static or homogenous. They are all varied and these dynamics must be understood.

The question is "Who is considered disabled within a particular cultural setting?" This raises many issues. In Binga, for example, hearing impairment is one type of a disability associated with mysteries and myths. Hard of hearing is associated with learning difficulties in rural areas of Binga. Pre-lingual deafness, which results in communication disability, has no association with hearing-impairment according to the local people. The Tonga people associate pre-lingual deafness with being bewitched or as a curse. If it is associated with witchcraft or thought to be God given it have fewer stigmas. Strong deaf adults are viewed by their communities as workers and are able to marry. Such attitudes arise from specific experiences and emotions driven by cultural beliefs. These experiences can have an enormous impact upon the lives of people living with hearing-impairment, both adults and children alike. Harper (1995) revealed that factors such as age, sex, contact, family attitudes, attribution (child's view on how the disability happened), chronicity, duration and culture have all been found influential in understanding the social psychology of disability.

In order to explore further the implications of this study we need to understand what other research found out. It is very clear that previous studies by Harper et al., (1986) which attempted to explore attitudes in relation to different situations concluded that it was not possible to make general statements about definitions or preferences without considering the context, (e.g. Who would you like to play catch with? Whom would you like to play chess with?). In each of the countries studied, cultural factors were also an influencing factor of preference. For example, in the USA obesity was found with negative associations and obtained the lower ranking. In contrast, in some countries affluence can be equated with food availability and body size, signalling wealth and power. Children in Nepal selected obesity as more preferable. In the Nepalese, Antiguan, Yucatan and Maori populations children with mobility impairments were often ranked as least preferred (Harper et al., 1986).

With labour-focused environments, such as in Binga district, hearing-impairment has no agricultural based activity limitations, but those affected are generally not employable in other economic sectors where literacy is required because most deaf adults never went to school. The reality in most of the rural areas in Zimbabwe is that a small number of hearing-impaired children attend school, but the majority of the hearing-impaired are neither identified nor receive any intervention. Even where children are assessed for hearing aids, there may not be affordable hearing aids, batteries, or access to specialist teachers and therapists.

Lack of services in rural areas in developing countries leads to the fact that local associations of people living with hearing impairment are seldom listened to and have minimal impact upon professional practice. For example, to influence the state to teach primary school teachers and parents sign language, or employ a deaf adult to teach deaf children sign language and act as a role model is very difficult in such traditional communities, but we all know that hearing impairment without appropriate intervention among young children can delay the acquisition of speech, language and communication skills, that in turn results in learning and other problems at school (Mauk et al., 1991).

These findings show that it is of paramount importance when working with mothers and carers, to consider their experiences and feelings. Our study shows that maternal expectations and cultures on child development vary from one location to another within the same district such as in Binga. This is confirmed by Pachter and Dworkin's (1997) study, which interviewed 255 mothers attending a paediatric clinic in the USA using semi-structured interviews. Maternal expectations of when a child was to achieve a social milestone were different in different cultures; even more complex was the wider variations from within the same culture. For example, this study found it was very difficult in Binga to assess 24 month-olds brought by their mothers complaining of pus-discharging ears.

It was very clear that most mothers or carers in the study area were worried about their children having ear or speaking problems and reported to have looked for cure from hospitals and traditional healers but failed to have a cure to make their children speak like other children. In Tonga culture a disabled child might be considered to be sick; consequently the mother or carer will wait for the condition to improve before seeking medical advice or may seek medical advice in search for cure, which is very expensive. Resignation towards disability as opposed to acceptance can delay mothers seeking rehabilitation services for their children. This may happen in cultures where disability is believed to be the result of a past sin or a curse (King and Burgess, 1993).

These findings led us to believe that experiences of disabled people will differ depending on the different cultural environments. Rejection of a disabled child can happen in a situation where the child is seen as an economic burden. I readily acknowledge that in some cultures, such as the Tonga culture, the hearing impaired girl is more vulnerable than the hearing impaired boy. The sex roles played by boys and girls or adult females and males are different. A woman is expected to look after children and other household chores in a traditional society. What explains this phenomenon is that to play the social constructed roles perfectly well is a disabling factor for most of the disabled people in such communities where survival skills are of paramount importance. This is confirmed by Coleridge's (1993) study which states that disability is closely associated with poverty and such experiences can, also, contribute to the vicious cycle, for example social exclusion leading to loss of opportunities in the employment market.

The study findings show that there are expressed needs by mothers, pre-and primary school teachers, health workers and other community workers in Binga to introduce an inclusion programme for the identified hearing-impaired children aged 36-72 months.

During meetings with the service providers it was emphasised that programmes should be introduced. These programmes should carefully assess the needs of the disabled persons in context of the specific cultural environment and take into account individual experiences. What explains the term "needs" is not only those assessed by the outsider, but also, include the felt and expressed needs by the hearing-impaired children and their mothers and carers.

This study found out that the cost of seeking a cure took Binga people as far as Bulawayo; a city that is 500-600km away and is beyond the reach of the majority. The transport and subsistence expenses were far from being affordable to an average community person living in the study area, but some parents reported having sold their implements (including farming equipment), to get money to secure treatment and a cure for their children's difficulty in speaking. This observation is confirmed by Lichtig's (1995) study, which cited that the cost of deafness to individual children and their families and the community in general could be enormous.

The other example was reported by Pongprapai et al's (1996) study in a cross-sectional screening survey in rural Thailand, which covered 1836 households and identified 53 children with disabilities after medical confirmation (Pongprapai et al. 1996). According to Pongprapai et al's (1996) study with respect to health seeking behaviour, 20 of the carers claimed that none had been sought citing reasons such as cost, inaccessibility and cultural beliefs. Of the remainder, 53% (n=17) sought traditional treatment only, 35% (n=12) had sought out western treatment and the rest had sought a mixture of both. In fact, this situation indicates the potential for a CBR programme so as to improve services for people with disabilities in rural areas (Pongprapai et al., 1996).

I believe that there are issues affecting parents with a hearing-impaired child in rural areas which among others are:

- Family problems; financial, child with disability and family conflict
- Family worries; health, education, marriage and occupation
- Family stress; burden

- Family feeling shame
- Receiving support from relatives, neighbours and little welfare from organisations

These observations confirmed our suspicions that the majority of the hearing-impaired children are at home not attending school, and families are less concerned about their children attending local school for educational rehabilitation but pre-occupied with irking for survival, worried about health issues and seeking information about and cure for their children's conditions. The results of the screening exercise were in agreement with these assumptions. All deaf children were at home even though they had reached the school going age. The situation was made worse by the fact that the local school system was not prepared to enrol deaf children.

I can no longer assume that mothers or carers were not interested in finding out about their children's hearing status because they showed great interest and attended screening sessions in great numbers (90% compliancy rate). Mothers or carers were keen to attend the screening exercise and the majority of them were seeking information about services available in the district.

This study lent us support to the assumption that families with hearing-impaired children have strong expressed needs for their children to acquire the best service available in the country. This is supported by one of the studies conducted by Simeonsson (1994) in China using a format designed for a previous study in the USA. A total of 101 families from both an urban and rural setting were recruited for the exploratory study investigating expressed and felt needs. The children in the urban community were from a higher socio-economic status and were students at a special school for hearing-impaired children. In contrast, the children from the rural communities had mixed disabilities (mainly developmental disabilities) and either went to a mainstream school or stayed at home. The urban families expressed significantly more needs than the rural families ($p<0.01$). The top three expressed needs for the urban families were seeking specialist help, locating a doctor and getting information on how to teach the child. The top three expressed needs for the rural families were information about the child's condition, paying for the therapy and information about present services. What has been observed in Binga is the need for an action to fulfil the expectation for basic necessities required in rural areas in Binga and other similar settings in Zimbabwe.

In order to succeed in these efforts, there is a need to improve on delivery of health care services, incorporating hearing-impairment issues within the existing curricula for training teachers, nurses and other health professionals. In addition there is a need to improve on the use of mass media and other related communication channels to educate and sensitise the general public on various topical issues regarding hearing impairment. It is of paramount importance to come up with legislation that covers such areas as provision of adequate care for pregnant mothers, children, and provision of basic facilities such as under five clinics which, also, screen hearing loss and adequate resource units established at mainstream schools, aimed at enhancing preventive measures and improving the literacy rate of hearing-impaired children in communities.

In view of the importance of providing appropriate services for deaf children, it has been the motivation of this study to design and validate a new low cost hearing screen to identify permanent hearing loss in children aged 36-72 months, in Zimbabwe. This point and many other related issues concerned with the appropriate services for deaf children in Binga district are discussed in the next section.

5.4 Appropriate services for deaf children in Binga

The results of the follow up data collected for this study showed that the simple 2001 training programmes revealed positive results: One 5-day and three 1-day workshops which were held and a total of 86 course participants (n=86) drawn from 5 study wards were trained for the purpose of providing relevant information and imparting relevant skills on the identification and rehabilitation of deaf children in the community. Participants completed a questionnaire before and after the workshop which collected data measuring their knowledge, skills, attitudes and practices (KSAP). The analysis of these questionnaires revealed that the knowledge, skills, attitudes and practices (KSAP) before and after the training workshop were different. After the workshop participants were more confident and positive towards deaf children compared with their responses before the training workshop. Twelve months later the data collected showed that the knowledge, skills, attitudes and practices (KSAP) of the trained subjects compared with the untrained ones were similar. These results indicate that the training workshops had cascading effects from the trained subjects to their colleagues who were never involved in the study.

The data collected during "Phase 2" of this study (12 months later) and analysed to evaluate the simple intervention of training teachers, village community workers and health workers on screening permanent hearing loss show the importance of continuous assessments of community research or service delivery programmes in developing countries. Data collected during the 2000 to 2001 period were satisfactorily complemented 12 months later during the follow-up evaluation which used a questionnaire and focus group discussion guide data collection instruments during the period from May to June 2002. The children who failed the pure-tone screen survey were also followed up to ascertain their inclusion at local pre-and primary schools in the five study wards in Binga. This evaluation, therefore served as an assessment of the impact of the afore-mentioned training programme implemented to improve the service delivery for deaf children by the partners namely, the Ministries of Health and Education in Binga.

The aim of the follow-up evaluation was to explore strategies of inclusion of hearing-impaired children in the mainstream activities in the study wards. It was hypothesised that training can change attitudes and practices of the professionals. The main findings of this qualitative assessment of "Phase 2" of this study are discussed in the focus group outcomes detailed below.

Focus group discussions of stakeholders in education

The responses from the trained (T) and untrained (UT) pre-school teachers and trained (T) and untrained (UT) village community workers clearly show that the community in Binga district is aware that deafness is a problem, for example one pre-school teacher confirmed this,

> *"....yes, deaf children are there in our area",* said by T.

There were mixed views of what caused hearing problems in children, some thinking witchcraft could be part of the cause. This is expected in a community which is still traditional, such as Binga. Despite a mixed view on the causes of deafness in children there was a strong agreement in both trained and untrained groups that they should be steps to improve deaf children's welfare such as a need of identifying deaf children in their community. These views were strongly expressed by both trained and untrained pre-school teachers and village community workers,

> *"....yes, deaf children should be sent to school so that they receive education...they are supposed to be sent to school because they must learn...they should be enrolled at this same school where their hearing peers are to be able to play together...I was thinking that if it was possible even here, deaf children are all identified, then there be a class of their own and a teacher for them",* said by UT.

Some untrained village community workers felt that a special school was a better place for deaf children to be educated at, this is well illustrated by these responses,

"...for some of us, the views that we have, we were thinking that there be a school for those who are deaf...just like there is an exclusive school for blind children", said by UT.

The people in the rural areas are convinced that deaf children should be given equal opportunities like their hearing peers to attend the ordinary schools. The people are also realising the inadequacy of their local schools in handling deaf students and suggested the establishment of a special class for deaf children at these schools.

Deaf children are not treated differently as regards to doing household chores in the family compared with their hearing siblings and peers. This point was disputed by the responses from the groups for example,

".... yes, they do some of the things as hearing children do", said by trained pre-school teacher (T).

"...umm, she does some play activities like cooking for each other...she does it if she sees others cooking in small tins...she also fetches some water and cooks" said by untrained village community worker (UT).

There are other people who believe that deaf children have different capabilities and so would not have similar competencies as their hearing peers and would do things differently than their hearing peers. An example from the quote is,

"...no, they don't do things as others because you will find that she or he is doing different things from what you are doing...no, they don't do similar things", said by UT.

The differences mentioned were mainly attributed to the poor communication of deaf children with the peer group, siblings, parents and other members of their community. It is believed that they were not confident in conversing with them and their conversations were at a superficial level. This is clearly illustrated by the following quotes below,

> *"...some of us think it is at a superficial level because at times you are busy playing with the deaf child you communicate only that he understands just like that...no, I don't talk at a deep level since he does not talk...yes"*, said by UT.

This limitation was with the families or people using verbal communication medium as opposed to signing. Those people who also sign believe that communication with deaf children can be deeper than normally thought by the majority of the village people, for example one pre-school teacher confirmed this,

> *"I communicate with the deaf children at a deep level because these children are also sent on errands like hearing children do"*, said by T.

There was an agreement in both trained and untrained groups that the proper way of communicating with deaf children is usually what the child understands better i.e. verbal, nonverbal or combined verbal and nonverbal communication at school and home. The groups both seem to agree on a variety of ways of communicating with deaf children in their community.

There are still some negative attitudes about deafness among community members. It cannot be simply assumed that training can immediately transform into positive attitudes after the trainees are transposed with facts about the causes of the hearing loss and the disability thereafter as a result of the impairment. Training did not entirely remove the negative attitudes towards hearing impaired children; for example, some trained village community workers reported that when they see a deaf child they feel pity, pain and sorrow for the child and the family.

Clearly, on the whole, training of the professionals by this study had positive impact on the practice of the trained group who reported having effected an action response on discovering a deaf child in their community. There was a strong agreement that the action taken on discovering a deaf child was to refer the child for treatment and rehabilitation at Binga Hospital and that if the child does not get better local herbalists should be tried as well. The majority of the respondents referred deaf children for medical treatment at clinics and for educational rehabilitation at local schools.

In spite of the respondents agreeing on sending deaf children to an ordinary school some felt that the performance of deaf children at local schools was poor. With consideration and special attention, the trained groups were very positive that deaf children could do better if treated accordingly because they are able to work out maths solutions on their own. However, the untrained groups felt that there was little progress noted on deaf children's performance at local schools. The sentiments of poor performance of deaf children at an ordinary school are very strong in Binga community. The Ministry of Education has very little input in trying to improve the education of the deaf at ordinary schools. For example, teachers are not even given basic training on how to handle and teach deaf children and as a result children enrolled at such schools just fill the class but have very little input from the teachers and the whole educational system.

To sound very negative with the integration programmes is not the point I would like to make here, but that, the education system in Zimbabwe is very inadequate and therefore needs a total revamping.

It was noted with interest how the local community value hearing in context that one rural setting is different and unique. For example, there was an agreement in both trained and untrained groups that deaf children are in constant danger in rural areas in Binga where wild animals like elephants co-exist with people in the same environment, because they cannot hear the danger in advance to avoid it. In view of this the respondents strongly felt that the Ministry of Education should also look into issues of training pre-school teachers on how to handle and teach deaf children survival skills.

Comments from the results of questionnaire responses

There were interesting responses obtained from 32 trained and untrained school heads and health workers on the following issues; importance of enrolling deaf children, awareness of organisations they could refer deaf children to further investigations and assistance, children recommended for hearing aids and those children who were actually fitted with hearing aids. The main findings of these issues are discussed in detail below.

The questionnaire respondents concurred with the pre-school teachers and village community workers in the seven focus group discussions that it is important to enrol deaf children at an ordinary school with some having some reservations about this and pointed out that it does not make any difference enrolling or not enrolling them at ordinary schools because of the poor quality of education they usually get at these institutions. But all respondents agree on doing something for the deaf children at local level and suggested an improved education system and a creation of special classes annexed at an ordinary school. The people's concerns on the quality of education for deaf children in the community are very pertinent and the authorities need to attend to such issues. It was very interesting to note that 66% (n=21) of the respondents were aware of organisations they could refer deaf children to, for further investigations and assistance (n=21) compared with 34% (n=11) of the respondents who did not know where else they could refer deaf children for further assistance.

Despite the respondents having knowledge about where they could refer deaf children, for example fitting of hearing aids, 66% (n=21) of the respondents did not recommend any child they identified as deaf, for fitting a hearing aid, compared with only 19% (n=6) of the respondents who recommended fitting a hearing aid. The reasons why the respondents did not recommend hearing aids were various. This study does not furnish us with evidence of reasons for not recommending hearing aids for children identified as deaf by the teachers and health workers.

I can only assume that one of the reasons could be that the few deaf children who could have been referred might not have benefited from such referrals because of costs involved such as maintenance and replenishing of batteries which make it difficult for the child to optimise the sound input provided by a hearing aid. This could be compounded by the fact that such services are usually located in towns 500 km away from Binga; whereby the transport costs and other expenses to and from the cities such as Bulawayo is beyond the majority of the poor Binga residents. The respondents shed some light on this issue by the fact that 72% (n=23) of the respondents who recommended a deaf child for fitting a hearing aid reported that they didn't get one fitted, as compared with only 13% (n=4) of the children who were recommended to have hearing aid fitted, who got one.

Enrolled deaf children at local schools

This study clearly demonstrated that a simple intervention in rural and poor areas such as the study location could transform in benefits being realised within a short period. The impact of training teachers, health workers, village community workers and others was realised within 12 months of the initial training. There were 110 children who failed the pure-tone screen aged between 36 and 72 months in the five study wards. The majority of the identified deaf children were still young for primary school placement but 6 of them who were aged 72 months during the 2000 to 2001 screening period were assessed for school placement for school term beginning January 2002 at four primary schools in four of the five study wards. It is noted with interest that the six deaf children of the school going age identified during 2000 to 2001 screening sessions were all enrolled at local schools. The quality of involvement in various activities at school was reported satisfactory, especially with the social skills as would be expected. This study has demonstrated very clearly that a screening programme even in very remote areas such as in Binga can transform into benefits for the identified deaf children. The findings presented and described by the study confirmed the hypothesis that the "Questionnaire" screen can be used by a non-specialist trained audiology worker reliably in identifying permanent hearing loss in children aged 36-72 months.

I believe that a number of ways can be adopted to minimise the prevalence and the impact of hearing impairment in children in Binga, and in many rural areas in Zimbabwe. One way could be to apply an effort to educate the community on causes and treatment of hearing impairment. Another way could be establishing screening programmes for pre-school and school going children.

The confirmed deaf children in the study area were enrolled into the surveillance programme which was an intervention component introduced by this study in an attempt to integrate these children at pre or primary school. The introduction of intervention based activities that could be carried out by pre and primary school teachers and village community workers (non-specialists) such as supporting parents, carrying out home visits, using signs to communicate and involving deaf adults as role models, served to challenge the negative attitudes observed in the community.

I acknowledge that lack of awareness on issues concerning deafness in children by most parents makes it very difficult to identify deaf children early enough for early intervention. Clearly, this led us to believe that hearing impairment in children aged 36-72 months in Zimbabwe, especially those born to families with little experience of disability, usually remains undetected until well past the pre-school period. This problem is made worse by the fact that there are no screening services in rural areas. The few audiology referral centres are located in cities whose services are inaccessible for reasons of cost and distance to the poor populace living in remote places such as Binga.

This study offers clear evidence that the "Questionnaire" screen can identify sensorineural hearing loss in excess of 50dBHL across all frequencies. The findings indicate that a mother or carer can intuitively suspect hearing loss in their child of moderate and severe levels when it starts to interfere with the child's speech, usually in older children. These results show that asking the mother or carer if she is worried about her child not hearing properly could identify about 70% of cases of permanent hearing loss. Any trained fieldworker such as a rehabilitation technician, a pre and/or primary school teacher, a village community worker or a village health worker can use the "Questionnaire" screen with ease to identify deaf children in the community and this has been demonstrated by this study.

I have no doubts that a screening programme with follow-up awareness training for teachers could bring benefits to deaf children. There could be several questions that need clarification such as: what is the implication to families on the outcome of screening hearing loss in children? What are the appropriate interventions and guidelines for improving communication skills of hearing impaired children living in rural areas? There are no simple answers to such questions but the experience gained from other programmes the world over might cast some light on the likely impact and implications of screening programmes to the deaf child and her or his family.

Societies the world over are making concerted efforts to address the social and psychological needs of those with various disabilities. Their main thrust is to try and give these children an education that will, in addition to giving them skills to earn a living, also empower them psychologically to integrate fully in the society, without being negatively affected by their disabilities. One school of thought that is gaining popularity is that educating hearing-impaired children in special schools isolates them and shows them that there is something wrong with them, thus giving them dispositions of inferiority (Naicker, 1997). It is therefore argued that these children should be integrated into a regular school setting and all efforts be made to enable them to experience the effective sound curriculum that the special schools attempt to provide, but do so in this integrated setting.

In many education systems it was believed over a long period that to provide an effective education for the hearing-impaired children, special schools with special equipment needed to be built for children with a particular impairment. These schools would then be equipped with specialised personnel who were able to teach these children. Zimbabwe has many such institutions like Morgenster School for the Deaf, Emerald Hill School for the Deaf, King George V1 and Jairos Jiri Association's Naran Centre for the Deaf. Although these schools have been considered to be doing a good job, the isolation of hearing-impaired children has since come under attack.

I believe that the case for integration is an attempt to address the issues of needs and rights as pre-requisites to the integration of Special Education Needs in general. This view is reaffirmed by delegates of the World Conference on Special Needs Education representing 92 governments and 25 international organisations in Salamanca, Spain who re-affirmed their commitment to Education For All (EFA), recognising the necessity and urgency of providing education for all children with special educational needs within the regular education system (UNESCO, 1994). According to this re-affirmation, there must be a genuine equalisation of opportunities for all. That has not been a reality in Binga and other rural areas in Zimbabwe.

The Salamanca delegates rightly endorsed the framework for action on Special Needs Education representing those governments, and the spirit of its provisions and recommendations may guide organisations. It appears that disability could be approached as a rights and development issue. With reference to rights, Naicker (1997) agrees with the South African National Disability Strategy Document of 1996, which states that disability, is a human rights and development issue.

The document argues that:

i. The principle of equal rights implies that the needs of each and every individual are of equal importance;
ii. Persons with disabilities are members of the society and have the right to remain within their local communities;
iii. Reconstruction and development of our society, therefore, involves recognising and addressing the developmental needs of disabled people;
iv. Development's ultimate goal is an inclusive society, which recognises and values individual differences and acknowledges common humanity and equality (Naicker, 1997).

The message from this framework for action and re-affirmation is clear; that full citizenship to all people regardless of their impairments must be afforded equal opportunity. This philosophy is consistent with part of the Salamanca Statement, which argues that regular schools with this inclusive orientation are the most effective means of combating discriminatory attitudes, creating welcoming communities, building an inclusive society and achieving education for all, moreover, they provide an effective education to the majority of children and improve the efficiency and ultimately the cost effectiveness of the entire education system (UNESCO, 1997).

I believe that some of the appropriate services for deaf children include their integration into the education system. In the same vein the South African Federal Council on Disability in 1995 called for the development of an integrated education system for all children irrespective of their capabilities. This principle is further confirmed by Naicker (1997) who argues that learners with special education needs have a right to equal access to education at all levels in a single inclusive education system that is responsive to the diverse needs of all learners, accommodating both different styles and rates of learning as well as different language needs in the case of deaf learners where their first language is sign language, and ensuring quality education to all through appropriate curricula, organisational arrangements, technical strategies, resource use and partnerships with their communities (Naicker, 1997).

My assertion, on the philosophy of equal opportunity entails that every person shall have the right to basic education and equal access to educational institutions in an environment of her/his own choice. Provisions of education in integrated settings are believed to provide an effective education to the majority of children and improve the efficiency and ultimately the cost effectiveness of the entire education system. With this in mind, the World Conference on Special Needs Education (1994) saw fit to call upon all governments and urge them to adopt as a matter of urgency, laws and policies that would ensure that children with various disabilities are educated in regular schools unless there are compelling reasons for doing otherwise. But scholastic achievement versus social inclusion in large rural schools is an issue that would need addressing.

I acknowledge that the Salamanca guidelines create a range of different challenges to the school system. For example, children experience various difficulties in learning at some point during their schooling. In this instance, the schools must be found ready to provide ways and means of meeting individual special educational needs otherwise the whole philosophy of integration will be tantamount to paying a lip service. The fundamental question is whether our schools are able to provide these special needs of the impaired children in the same classroom as non-disabled children. If they are not, this arrangement could worsen the disadvantages faced by these pupils. It is argued that the integration of children with special educational needs is best achieved within similar educational and social contexts. It is within this context that special needs children can achieve the fullest educational progress and social integration.

While it is generally accepted that integration provides a favourable setting for achieving equal opportunity and full participation, children's success requires a concerted effort, not only by teachers and school personnel, but also by peers and parents. It must be realised that educational reform is not only a technical task; it depends, above all upon the co-operation, commitment and good will of the individuals who constitute any society. Above all, there has to be adequate resources. The arguments advanced above in favour of integration of hearing impaired children into regular school setting are very convincing and persuasive. No wonder the trend today is to move from the specialist school for children with Special Educational Needs to the integrated approach in the normal school setting. Several researchers generally agree upon this view. For example, Lynas, Lewis and Hopewood (1997) observed that this trend started in the mid 1970's and by 1997, 85% of deaf children in the UK were in mainstream schools. In addition, 60% of the specialist teachers of the deaf were operating in mainstream schools. Indeed, some higher learning institutions in Africa have produced some outstanding lawyers and teachers in integrated learning settings (Peresuh and Ndawi, 2000).

I strongly recommend the introduction of an integration programme in local schools in Binga District to include most deaf children living in this area. This recommendation has an implication on the reorganisation of the service delivery systems, which I believe is a worthwhile attempt by government and non-governmental organisations.

5.5 Implications of the study

The preliminary study revealed that a number of children in the sample (n=1048) showed problems or difficulties in speaking. There were 117 (11.2%) children identified with communication problems in five wards. Our findings thus lend support to our concerns of the implication of hearing loss in young children if discovered late and no appropriate intervention was initiated early enough to reverse the negative effects. All children with problems or difficulties in speaking are at risk of hearing loss. Despite the fact that the "Two-question" recruitment tool did not aim to identify deaf children but those who had a high risk of deafness, the extent of such a high proportion (11%) of children identified as at-risk is expected to have an implication towards service delivery for children with communication problems in Binga ($p<0.001$). There was not much difference in the number of cases reported with difficulties in speaking between boys and girls ($p>0.05$). This finding is of considerable importance since it confirms that the incidence of communication problems is not confined to a single sex (White et al, 1998; Yoshinaga et al, 1996). The gender differences about communication needs in the family in young rural Zimbabwean children have more bearing on girls than boys. Girls look after their siblings and help their mothers with household chores at a tender age of 5 to 6. Communication difficulties in young rural girls have far more disabling effects than in boys.

The other important finding revealed by the recruitment tool was the significant proportion of children (35%) who were identified and were reported by their mother or carer as having pus discharging ears or other ear diseases ($p<0.001$). This study does not have enough evidence that otitis media can lead into difficulties or problems in speaking because the "Two-question" recruitment tool was not designed to measure the implication of otitis media on speech. However, mothers reported 62 (17%) children (n=362) with a history of pus discharging ears who showed speaking problems ($p<0.001$). Pus discharging ears in both girls and boys ($p<0.01$) are significant problems in Binga district. As said before, a difficulty in speaking is a significant problem in both sexes ($p<0.001$): girls (n=60) and boys (n=57), and cases were similar ($p>0.05$). It seems clear that in the three age groups, there were more children aged 48-59 months ($p<0.05$)

and 60-72 months ($p<0.05$) months affected by ear infections than the younger children aged 36-47 months ($p>0.05$). These discrepancies were noticed in this study. Another explanation of high incidence of otitis media might lie in the prevalence of infectious diseases and poor nutritional status of young children. There are no known at-risk factors for otitis media in the older children (aged 36-72 months) in this district. It could be that the older children's immunity would have gone down due to lack of food since the district is one of the poorest places in Zimbabwe. The Binga study confirms the increased ear diseases in children aged 48-72 months ($p<0.05$) in the rural areas (Chege, 2000; White, 1988; McPherson and Swart, 1997; Jones, 1974; Selly et al., 1995; Woodrow, 1997; Little et al., 1992; Hatcher et al., 1995; Bastos et al., 1995).

As said before, there was a significant difference in children with difficulties in speaking compared with children reported having had a history of ear diseases in the age group 36-72 months ($p<0.05$). The findings show that 44%, 56% and 62% of the difficulty in speaking groups were in ages 36-47, 48-59 and 60-72 months respectively. There were more children reported with difficulties in speaking in the older age groups than in the younger age group. This confirms earlier findings by several studies that mothers or carers are more concerned about the effects of hearing impairment rather than the impairment itself, it is hidden in young children and becomes apparent when signs of communication disabilities are the obvious identification (Schildroth and Kerchmer, 1986; Watkin et al 1995; White et al, 1998; Yoshinaga et al, 1996). The results seem consistent with the general belief that hearing loss is a significant problem in children living in rural areas in Zimbabwe (Jones 1974).

This study found that about 41% (299/738) of children otoscopic examined had pus discharging ears (purulent otitis media) and about 6% had wax filled ears. All the identified cases were referred to clinics or to a hospital. Before being seen by our screening team most cases with pus discharging ears or other ear infections had never sought treatment at local health centres. Also, it was found that children who failed the screen were never assessed anywhere else in the district or at specialised institutions in Zimbabwe.

Applications of the study

This study was identified and viewed as of paramount importance to teachers, community rehabilitation workers and rehabilitation technicians in providing them with the necessary skills and tools to identify and integrate deaf children in local schools in Binga District, Zimbabwe. I originally assumed that the study would make appropriate services available to the identified children. It was possible for the project to work closely with the Ministries of Education, Sport and Culture and Health and Child Welfare. As an intervention component of the project during the screening exercise deaf children were referred for rehabilitation services at local health centres and schools for the purpose of improving the identified deaf children's communication skills. Local schools and health centres in the respective communities were the first referral points.

Applying hearing screening tests to the pre-and primary school age entry is important because this age group is one of the high-risk population groups of ear diseases and deafness. Earlier findings by McPherson and Swart's (1997) study confirm a high prevalence of hearing loss in the age group of between 36 and 72 months. It is socially responsible to identify and rehabilitate deaf children to enable them cope with their educational needs at mainstream local schools.

This study shows that there is a need to establish an appropriate, simple and effective low-cost audiometric assessment protocol at health centre level in developing countries such as Zimbabwe. To a large extent, nurses, if in-service trained, could possibly carry out simple audiometric tests such as an otoscopic examination and audiometric diagnostic testing on children with high risk of hearing-impairment. This kind of otological examination is simple and possible at a health centre as long as there is a policy to screen high-risk children in the Ministry of Health. It is unlikely that non-specific audiology trained community workers or nurses would find it difficult to use a simple questionnaire screen to identify hearing-impaired children in the community.

These results lend support to the assumption that semi-illiterate village community workers (VCWs) could identify the at-risk children by using the "Two-question" recruitment tool. Non-specific audiology health staff (rehabilitation technicians) could use the "Questionnaire" screen with ease and reliability and can identify deaf children ($p>0.05$) compared with the pure-tone screen. In Binga, the rehabilitation technicians animated the mothers or carers so effectively that the latter were engaged during the "Questionnaire" screening process.

Although, there are many types of hearing screening protocols that are widely used in developed countries such as hand-held devices for audiometry testing (audioscopes) and are sensitive as screening tools for hearing deficits, no evidence is provided to ascertain their appropriateness and cost effectiveness when used in rural settings with no trained health staff. I believe that high technology audiological equipments are necessary for diagnostic purposes and are most appropriately used at referral centres such as at central and provincial hospitals where a pool of highly trained medical staff is available.

Overall, it appears that semi-illiterate workers such as village community workers are the pillars of the service delivery system in the rural areas, therefore, high-tech equipment such as audioscopes, audiometers and tympanometry machines to be used by VCWs such as in Binga are inappropriate and unacceptable protocols. The study confirms that both the "Two-question" recruitment tool and the "Questionnaire" screen is likely to be a more rapid and less expensive way to screen for hearing loss in children by non-professional rehabilitation workers (Laughton, 1994).

It appears that the "Questionnaire" screen if adopted by less income countries as a screening protocol, is an appropriate tool that could be reliably used after adapting to local needs to screen high-risk pre-school children. I believe the screening programme could benefit many deaf children in the mainstream educational system. The adoption of routine hearing screening and assessment of language development at pre-school centres would lead to improvement in the quality of educational performance of deaf children. I acknowledge that the technology used is mainly imported from developed countries, therefore more forethought and planning are required before training received in developed countries can be optimally used in less developed countries. Contrary to popular myth that audiological services in rural Zimbabwe are not necessary because the deaf are a minority population that need to be recognised as such, mothers in our study significantly oppose this theory and would do anything possible to secure a cure for their child not able to speak. There is adequate evidence from this study to recommend for a selective screening programme of pre-school and school going children for hearing deficits using subjective/behavioural means, such as the "Questionnaire" screen.

Despite several arguments concerning the effectiveness of certain treatment and rehabilitation regimes, the effects of early intervention in the pre-lingual period of the child's communication skills cannot be underestimated. The aim of early identification and intervention is to improve language and communication skills of children. The identification of deaf children and early intervention in communication rehabilitation and language development in hearing-impaired children aged 36-72 months in developing countries should be encouraged. Clearly, identification and intervention of hearing-impaired children can prepare deaf children for educational needs at school. The approach outlined in this study could be replicated in other rural areas in Zimbabwe and other developing countries. It is likely that delay in identifying hearing impairment and lack of appropriate intervention for deaf children can retard the acquisition of speech, language and communication skills. This can result in learning and other problems faced by deaf children at school (Mauk et al. 1991). I believe that appropriate interventions to reduce the occurrence of communication disabilities associated with hearing impairment are most successful if children are identified early and interventions are given. This study provided some evidence that those low cost tools such as the "Questionnaire" screen can be made available and could accurately identify sensorinueral hearing loss in young children. The approach of routine screen for hearing impairment in young children before the critical age of communication skills acquisition could reduce the average age at which children with serious hearing impairment are identified, usually above 60 months of age in rural Zimbabwe. It is important at this point to summarise the main findings of this study which are contained in the next section.

5.6 Summary of the main findings of the study

The mother's intuition about her child's hearing status led us to infer that a questionnaire screen can identify permanent hearing loss in children aged 36-72 months in excess of 50dBHL of the better ear averaged across all frequencies compared with a pure-tone screen. It was then hypothesised that the "Questionnaire" screen can identify 60% of children with permanent hearing loss in excess of 50dBHL averaged across the frequencies 0.5k, 1k, 2k and 4k defined by pure-tone audiometric results of the better ear and that non-specific audiology trained rehabilitation technicians can reliably use with ease the screen to identify deaf children in their respective areas.

The results confirmed the theory of the mother's intuition about her child's hearing, especially when the levels of hearing loss start to interfere with the child's verbal communication. Mothers are able to identify deaf children with permanent bilateral hearing loss in levels in excess of 50dBHL averaged across all frequencies. I cannot assume that mothers are able to identify mild and moderate cases of permanent hearing loss in young children below the age of 36 months because of their inability to detect verbal communication problems in this age group. I therefore acknowledge that mothers usually miss mild and moderate bilateral temporary hearing loss cases because they are only worried about their children not able to speak, the factor which is noticed later in the child's life. This is one of the risk factors of hearing loss in children. Clearly, this study was not able to isolate permanent hearing loss in children because the pure-tone screen was not able to detect whether all the cases who failed were permanent cases. The present study offers clear evidence that most cases that failed the screen had temporary conductive hearing loss because of the presence of otitis media (34%), which was highly prevalent in the target group (n=1048). About 11% (117) of the children of the target population were reported with difficulties in speaking and about 110 of them were deaf ($p<0.001$). The results show that hearing loss was a significant problem in Binga district.

The performance of the "Questionnaire" screen in identifying deaf children compared with the pure-tone screen was very high and is summarised as follows:

a) Sensitivity of the "Questionnaire" screen was 79%

b) Specificity of the "Questionnaire" screen was 96%
c) Overall performance of the "Questionnaire" screen was 93%.

The high specificity of the "Questionnaire" screen has a directional support to mothers or carers' worries about their children having difficulties in speaking and their responses to the interviewers and mothers or carers' instructions during testing time. The fact that the "Questionnaire" screen had a high specificity as opposed to sensitivity means that the screen would miss a number of cases of temporary conductive hearing loss, which normally clears itself within 6-8 weeks and has little impact on speech. The performance of the "Questionnaire" screen of this study is very remarkable bearing in mind that both its sensitivity and specificity were not expected to be higher than 75%. The ideal would be a 100% of both sensitivity and specificity for the performance of the "Questionnaire" screen but the reality of using a pure-tone screen as a referral protocol in a rural area with a high ambient noise posed some major challenges on this study.

Despite the fact that the "Two-question" recruitment tool was not meant to be a screening tool its performance in recruiting the at-risk children was significantly remarkable. The recruitment tool showed that it recruited the 417 at-risk children and 110 of them were later confirmed deaf by the pure-tone screen. This means that the recruitment tool has a directional support to mothers' worries about their children having difficulties in speaking and would include the majority of false positives and false negatives of hearing loss normally as a result of increased cases of children with a history of ear diseases. Usually otitis media with fewer complications clears itself within 6-8 weeks in these cases and has little impact on speech. However, recurrent otitis media infections can affect speech.

These results are consistent with previous research which clearly shows that the mothers or carers' worries about their children not hearing properly can identify about 50% cases of moderate cases of bilateral hearing loss as confirmed by the conventional means such as the pure-tone screen (Scanlon, 1999). Scanlon's (1999) study also found that a questionnaire screen can identify about 97% of cases of severe and profound hearing-impaired children correctly when compared with the pure-tone screen. Wirz, Hartley et al's (2001) study in Brazil confirmed that in cases of severe and profound hearing loss, the performance of the "Questionnaire" screen is remarkably higher and its sensitivity is estimated at 97% when compared with the pure-tone screen. These results therefore support the hypothesis that the "Questionnaire" screen can identify 70% bilateral sensorinueral hearing loss in excess of 50dBHL across four frequencies (0.5k, 1k, 2k and 4k) at least in children of ages between 36 and 72 months. It is very difficult to find a good reference test for younger children suitable for rural areas in Zimbabwe.

Therefore, children aged below 36 months were excluded by this study. These children are not developmentally ready for the pure-tone tests. The pure-tone test results of the children under 36 months are totally unreliable. Some of this age group are not developmentally mature enough to cooperate for the pure-tone test. The 36 months age group of our target group had some few children who were difficult to test but we maintained our gold standard of a pure-tone screen for comparison reasons. There are few available audiometric tests that can be reliably used as a gold standard to screen the 36-48 months age group in rural Zimbabwe. I rejected toy tests because they were not appropriate for the rural Zimbabwe because of cultural differences with the UK cultures where the toy tests were validated. For these reasons this study maintained the use of the pure-tone screen as the gold standard.

I acknowledge that this study was not able to identify bilateral sensorinueral hearing loss in children due to the fact that the pure-tone screen used as the gold standard was limited in this respect because the Kamplex screening audiometer used did not have a bone conduction testing facility. Furthermore, the ambient noise of about 30dBA in test classrooms of rural schools in Binga made it impossible to isolate true cases of sensorineural hearing loss. Reliance on these measures must be tempered in assessing degrees of hearing levels in sound treated rooms. Because a high degree of variability was found in the pure-tone screen data, it would be beneficial to replicate this study on larger and different populations. It would also be interesting to identify bilateral sensorineural hearing loss in the subjects by applying diagnostic audiometry over several periods of time instead of one cross sectional period.

From our results, the "Questionnaire" screen had a sensitivity and specificity of 79.8% and 96% respectively in identifying children in the sample (n=747), with and without bilateral hearing loss in the excess of 50dBHL averaged across four frequencies correctly as compared with the pure-tone screen respectively. These results are in substantial agreement with those of Sutton and Scanlon (1999) and Fonseca et al. (1999), which show that a questionnaire screen is highly specific because they are mainly based on mothers' accuracy in identifying mild and moderate hearing loss in children. I can no longer assume that mothers define cases of hearing loss as postulated by various international classifications such as that described by Davis and Silverman (1971) or National Deaf Children's Society (1994). Obviously, there are problems with the description and agreement of these classification models.

What explains the inability of mothers or carers to have suspicions of mild and moderate temporary cases of hearing-impairment in their children? One explanation may be that hearing loss is a hidden impairment and mothers only become aware when a child displays problems in speaking and this could be as late as 5 years of age with most cases of temporary conductive hearing loss. Although in most cases children with conductive hearing loss in excess of 30dBHL (Sutton and Scanlon, 1999) would fail the pure-tone screen, they would pass the "Questionnaire" screen, which mainly relies on parents' responses. Another possible explanation is that the interviewer's skills to perform subjective acoustic acuity tests are inadequate in detecting mild and moderate hearing loss in children.

These findings suggest that the majority cases of temporary hearing loss would pass the "Questionnaire" screen, which make the high percentage of false positives i.e. those failing a cross-sectional screening session. Most cases of severe sensorineural hearing loss would fail the "Questionnaire" screen because of its effects on verbal communication, the factor easily recognised by mothers or carers and the interviewers.

Bearing in mind that sensorineural deafness has a low prevalence rate estimated at 0.4-1 per 1000 live births. This would mean that there were few deaf children aged 36-72 months identified with this kind of hearing impairment. This study was not able to estimate cases of sensorineural hearing loss because of the limitation of the screening Kamplex audiometer used. When cases of otitis media are included the prevalence could be as high as 11% in this age (36-72 months) group.

It is interesting to note that two "Part 1" questions of the "Questionnaire" screen can identify about 50% of deaf children, these are:

- Question 14: "Do you have special worries about your child's ears?"
- Question 15: "Do you think your child is deaf or does not hear properly?"

The two questions above show that the mothers or carers would only identify about half of the cases that might be identified by a pure-tone screen. These results clearly show that mothers or carers would miss most temporary cases of mild and moderate hearing loss. One possible explanation is that mothers or carers are very sensitive to their children not being able to start to speak but that they do not worry about their child not hearing properly. This shows that popular thinking of trusting the mother or carer's intuitive behaviour about their children's hearing problems is a simplistic theory and cannot be taken at face value (Sutton and Scanlon, 1999; Fonseca et al, 1999). On the other hand the experience and competence of mothers or carers to observe sound acuity in everyday life is inadequate for a screening session to solely depend on the mother or carer's responses without performing further sound detection tests that were included in the "Questionnaire" screen such as the observation tests (OB1 and OB2) for each child during a screening session. These results have also shown the relationship between age and sex in the distribution of cases of hearing loss. It was found that there were similar cases of hearing loss between both sexes in this study.

I also believe that it is possible, because of cultural differences, to use this study in other districts in Zimbabwe which may produce different results. It is important to emphasize that methodological problems in the research design might limit our general interpretation of these results to include different rural settings in the country. It can be asserted that the approach outlined in this study could be replicated in other culturally different areas in rural and urban settings in order to construct a typology of a process of detecting permanent hearing loss in children. The limitations in field experiments not withstanding, this study suggests that the "Questionnaire" screen can have a favourable impact on deaf children and service delivery programmes in the rural communities in Zimbabwe. The continuous demonstration of the "Questionnaire" screen's reliability and validity would reinforce and aid the screen's usage and its acceptance by the service providers.

On the other hand the reliability of the "Two-question" recruitment tool and the "Questionnaire" screen led us to believe that it is possible to estimate prevalence of pus discharging ears and hearing loss in excess of 50dBHL across all frequencies in children aged 36-72 months in Binga district to be between 10% and 15%. This study did not find out at-risk factors associated with hearing loss in children in the study area. It would be interesting to measure the extent of the risk factors associated with hearing loss in children in rural Zimbabwe.

5.7 Lessons learned from the project

This section is devoted to my reflection on the process I experienced during the implementation of this PhD project. It serves as an evaluative exercise of the project work in both theoretical and practical aspects. These are the three questions, which helped me to reflect through the process of this project:

i. What would I change or do differently?
ii. What practical advice would I give for a similar project?
iii. What I gained from this project?

I have considered my personal achievements as well as the skills acquired during the period and concluded the section by giving practical guidelines for further similar studies and/or service delivery programmes in developing countries.

What would I change or do differently?

If I had to re-design this project, I would change a number of things. The obvious noticeable change would be the aim of the project, which would be stated differently. Instead, the identification of deaf children would be part of the process of providing appropriate education services for deaf children in ordinary schools. I would emphasise on service provision and carry out an intervention study. Then I would try to mobilise more of the available resources in the community e.g. deaf adults and local Sign Language. In an intervention project baseline and end of project, implementation studies are very important to measure changes, which could be brought about by the project. This approach was beyond this PhD project.

The twelve months evaluation of this project achieved less than it could have done because there was no baseline study conducted before the training; therefore, it was not possible to measure the impact of the training programme effectively. The screening exercise was a valuable procedure which was sucessful in identifying 12 deaf children who would not have otherwise had any education. The teachers and pre-school teachers were able to identify, enrol and work with deaf children in their schools (n=12) and that these children were performing satisfactorily in communication and social skills. A different design would have enabled me to collect more qualitative data and understanding the qualitative process, which we know is a very important aspect in improving service provision for deaf children in community work.

The project could have made better use of village community workers and pre-school teachers after the "Two-question" recruitment tool in the full hearing screening rather than using the rehabilitation technicians who are based at the district level and rarely visit villages which are poorly served by unmade seasonal roads. Village community workers and pre-school teachers are local people selected into these jobs by their respective communities. They are usually mature married women who are well respected and are permanently settled in their respective villages and capable of further training. In a calmer political climate it would have been of great value to run a seminar for prominent educationalists and health personnel to explain project results and the value of integration of deaf children. We should have found ways to work effectively with parents of deaf children and deaf adults in the community in addition to the work being done in school.

What practical advice would I give for a similar project?

There are several factors that could improve the implementation of similar projects in future. Some of these are listed below:

- To support non-specialist trained pre-and primary school teachers to identify and enrol deaf children.
- To facilitate and organising in-service communication skills training programmes (local informal signs and Zimbabwean sign language) for teachers, parents and deaf adults.
- To develop a portfolio, which would include 3 sections: training materials, the "Two-question" recruitment tool and the "Questionnaire" screen validated by this study.
- To organise and support the training programmes for village community workers, pre-and primary school teachers to identify and include deaf children in mainstream education system and encourage them to network with collegues from other villages.

- Networking with other service providers for resource and sharing ideas for the purpose of improving education for deaf children in the country and to influence national governments, local and international organisations to formulate policies biased towards resource allocation for the education of deaf children.

What I gained from this project?

One of my supervisors had an opportunity to visit and work with me in Binga, Zimbabwe for two weeks. The support I received from my colleagues at CICH and in Zimbabwe, equipped me with skills and courage in dealing with difficult situations in the field. The teamwork made it easy to introduce the project in the rural communities and community leadership. The formulation of the project proposal and its inception in Zimbabwe was done in a consultative way and was linked with other service providers as partners e.g. Ministries of Health and Education, UNDP and Binga Rural District Council. Networking with partners developed my interpersonal communication skills, which increased my co-ordination skills in managing this project.

I worked very hard in motivating the project volunteers by giving them appropriate training, effective supervision and systematic monitoring of their work in progress during the implementation of this project in Binga, Zimbabwe.

I have raised the project's profile by presenting the work in progress at various world conferences e.g. in Melbourne and Alice Springs, Australia at the World Conference on Rural Health (WONCA), Kampala in Uganda at the Community Based Rehabilitation (CBR) Africa Region Conference, Alexandria in Egypt at the Save the Children Global CBR Consultative Conference and in Lima, Peru at Save the Children Alliance Conference on Inclusive Education. My presentation skills were tremendously improved through several internal coaching clinics at CICH and UCL graduate school and regular feedback meetings and poster competitions, where I scooped one of the prizes.

During the PhD training programme my writing skills were enhanced and these are demonstrated by the project proposal I compiled, which was sent to different funding bodies e.g. the United Nations and Nuffield Foundation, who eventually funded the project and, also through several articles written and published in some renowned journals e.g. the Royal Society of Hygiene and Tropical Medicine, World Conference in Rural Health Handbook, African Journal in Special Education, CBR Africa Region Conference Book (two articles in Hartley ed. 2002). It is important for Southern African Universities to use the results of this study to influence governments and NGOs to formulate policies on the identification, integration and improving the quality of education for deaf children in the region.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

CHAPTER 6

6.0 Conclusion and recommendations

This chapter concludes by discussing what this study adds to the existing knowledge on screening hearing loss in young children and gives recommendations for future research and practical applications for consideration. The concluding discussion and recommendations are ordered in two subsequent sections 6.1 and 6.2.

6.1 Conclusion

This study has provided future studies or service delivery programmes with a valid low cost "Questionnaire" screen to identify deaf children in rural Zimbabwe and other countries. The results are of considerable importance since it suggests that the intuition of mothers or carers' regarding hearing status of their children is confined to a single view and would only identify half the children. Methods of sound acuity measurement such as simple observation test techniques are to be included in the refined and recommended "Questionnaire" screen (see Appendix XVIII).

On the other hand, the interviewers do not necessarily need a health background but need to have a community exposure such as village community workers, or pre-and primary school teachers. Given a practical oriented intensive training course on how to use the "Questionnaire" screen, for example can prove to be an effective and valuable way of imparting knowledge, skills and practice (KSP) on screening hearing loss in young children by using the "Questionnaire" screen. The curriculum should emphasise the practical competences in screening hearing loss in children to make sure that complex issues are included and dealt with satisfactorily before the actual screen takes place.

I would suggest that future research into validation of the refined "Questionnaire" screen should be conducted in developing countries as a way of supporting and improving service delivery programmes. The study seems to demonstrate that this behavioural approach to screening hearing loss in young children could lead to new important findings about understanding cultural definitions of disabilities as a result of hearing-impairment and try to introduce programmes most appropriate for a particular community.

I recommend that future research should try to set a cut-off point of the pure-tone higher than 50dBHL and conduct an intensive training programme for teachers, health workers, village community workers and further evaluate the performance of the "Questionnaire" screen in identifying mild and moderate hearing loss in children. The refinement of the "Questionnaire" screen should be undertaken, pre-tested and validated once again in rural Zimbabwe or elsewhere in Sub-Saharan Africa. Moreover the pure-tone tests should be highly reliable and consistent throughout the programme at 40dBHL so that comparisons are widely applicable. From these results, I believe that the optimal level of both sensitivity and specificity of the "Questionnaire" screen can be improved to between 80% and 85% respectively in identifying bilateral sensorineural hearing loss in excess of 50dBHL averaged across all frequencies in children aged 36-72 months.

The limitation (to measure threshold and to determine the type of hearing loss) in field experiments not withstanding, this study suggests that the "Questionnaire" screen may have a favourable impact on performance of deaf children at school and might have a bearing on the satisfaction perceived by their families from services implemented by development agents in the community. It is possible of course to eliminate all poor performing questions of the "Questionnaire" screen. Pre-testing the "Questionnaire" screen once more at similar settings in rural areas could improve the performance of the screen further.

I also recognise that testing the screen in a different cultural setting might produce different results but would reveal very important aspects to understand the performance of this screen in other settings different from the Binga situation and culture. It is important to emphasise that methodological problems in this research design limit my interpretations and generalisations. But the methodology improvement in the technique of applying the pure-tone screening could produce reliable test results and eliminate much of the confounding factors affecting this study.

The approach outlined in this study can be easily replicated in other rural areas as well as in urban areas to include varied cultural differences in order to construct a typology of the performance of the "Questionnaire" screen in a variety of cultural settings. It would also be interesting to further measure the benefits received by the identified deaf children integrated at the mainstream educational system. The data on the integration of 12 children identified by the study has provided some evidence of the benefits of the integration programme at ordinary schools in Binga district.

Subsequent studies testing such new tools should be designed as supporting efforts of research programmes complementing service delivery community programmes. It can be asserted at this stage that the "Questionnaire" screen is a valid tool in identifying bilateral sensorineural hearing loss in children. Less specific audiology trained community rehabilitation workers can reliably use it and is also a low cost screening tool. Reinforcement of the use of the "Questionnaire" screen and continuous reinforcement while using the referral system should aid in the refinement of the tool, its acceptance and use. It would also be interesting to measure the quality of life of deaf children and the family's satisfaction with the services provided over several periods of time instead of one pre- and one post-intervention assessment, as was the case in this study.

6.2 Recommendations

I therefore recommend:

i. That the revised "Questionnaire" screen (see Appendix XVIII) should be used in rural settings by rehabilitation technicians and other community workers to identify deaf children.

ii. That the "Two-question" recruitment tool should be used in rural programmes to identify at-risk children for deafness and possibly other low prevalence conditions.

iii. That screening of at-risk children should be done for the purpose of identifying deaf children for educational rehabilitation at pre-and primary school.

iv. That the community-based rehabilitation programmes for deaf children in rural Zimbabwe should be culturally appropriate, acceptable, accessible and affordable for the majority of the poor population.

v. That the inclusion of deaf children at rural schools and in the mainstream socio-economic activities be pursued and supported by the government and NGOs implementing community programmes in rural areas. These programmes should be well planned and resourced.

vi. That the recommended questions of the "Questionnaire" screen can be culturally adapted and used to screen hearing loss in children aged 36-72 months in rural areas in developing countries (see Table 6.1).

Table 6.1: Recommended questions (Q) that can be culturally adapted and used to screen hearing loss in children aged 36-72 months; questions 1-7 are concerned with collecting the bio-data (see Appendix XVIII).

"Questionnaire" screen	Questions recommended
"Part 1" of the "Questionnaire" screen (Ages: 36-72 months)	Q8: Is there a family history of deafness? Q9: Was your baby born with low birth weight (<1500g)? Q14: Do you have special worries about your child's ears? Q15: Do you think your child is deaf or does not hear properly?
"Part 2" "Section A" of the "Questionnaire" screen (Ages: 36-47 months)	Q19: Does s/he watch the speaker's face and mouth? Q21: Does s/he become frustrated easily when listening? Q23: Does the child seem particularly attentive to visual cues? Q24: Is the child talking?
"Part 2" "Section B" of the "Questionnaire" screen (Ages: 48-59 months)	Q28: Does s/he usually watch the speaker's face and mouth? Q31: Do you think s/he understands better when s/he is facing you? Q33: Does the child seem particularly attentive to visual cues? Q34: Do you understand him when you are not watching him, e.g. when you have your back to him?
"Part 2" "Section C" of the "Questionnaire" screen (Ages: 60-72 months)	Q38: Does s/he usually watch the speaker's face and mouth? Q39: Does s/he become frustrated easily when listening? Q40: Do you think s/he understands better when s/he is facing you? Q42: Is the child's speech/language more difficult to understand than other children of her/his age group?

The study achieved its objectives of producing a low cost "Questionnaire" screen that is reliable and can be used in screening hearing loss in young children in rural areas in developing countries. The refined and recommended "Questionnaire" screen is presented in "Appendix XVIII". Table 6.1 shows that the recommended screen has a reduced number of questions that renders it even easier and faster to administer by non-specific trained audiology workers in rural areas.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

CAN YOUR CHILD HEAR?

(SCREENING HEARING LOSS IN CHILDREN UNDER 6)

INSTRUCTIONS TO THE INTERVIEWER ON HOW TO COMPLETE THE

QUESTIONNAIRE

This questionnaire is divided into:

a) **Part 1**; General information for each child

b) **Part 2**; Sections **'A'** to **'C'** Specific Age Group of the Child

Please fill in Part 1 and the relevant **section** from Part 2 and record your observations

RECORD YOUR SUMMARY BELOW:

SUMMARY: (COMPLETE LAST, AFTER OTHER QUESTIONS)

Observations (OB) Scale:

Please, place a cross (X) on the scale provided below your observations about the child's hearing responses to your and mother's instructions:

Always *Never*

|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|

0 1 2 3 4 5 6 7 8 9 10

Indication of hearing loss: Yes [ ] NO [ ]

*(Please **tick** Yes or No box)*

Please Comment:

Name of the interviewer: .... Date: ....

'CAN YOUR CHILD HEAR?'- QUESTIONNAIRE

PART 1 **(For Every Child)**

GENERAL INFORMATION ABOUT THE CHILD

1. Village:……..……………………………… 2. Ward:……………………………...

3. Name of the Child: …………..…………..………………4. Sex: M [ ] F [ ]

5. Age: ………..(months) …………(years) ……………(year/month - local event)

6. Date of Birth:……………………………………………………………………

7. Name of School:……...……………………………...……………………….

(Please tick the 'yes' or the 'no' box below as honestly as possible. Thank you.)

	Yes	No	Don't know
8. Is there a family history of deafness?………………………………………………..			
9. Was your baby born with low birth weight (<1500g)?………………………………..			
10. Did your baby breathe properly after birth?…………………………………………			
11 Did your baby look yellow at birth? ……………………………………………...			
12. Did your baby have any fever after birth?………………………………………… **If yes, please specify ……………………………………………………………….**			
13 Did you have any illness during pregnancy?……………………………………….. **If yes, please specify ……………………………………………………………….**			
14. Do you have special worries about your child's ears?……………………………..			
15. Do you think your child is deaf or does not hear properly?…………………………			

Part 2

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section A

<u>36-47 months old</u>:

	Yes	No	Don't Know
16. Can s/he point to an object or a picture in a book upon hearing them named?...			
17. Does s/he pay attention when s/he is in a group listening to a story?...............			
18. Can s/he point to at least one part of her/his body, when you ask her/him in a quiet voice?...			
19. Does s/he watch the speaker's face and mouth?.......................................			
20. Does the child seem to strain when listening?..			
21. Does s/he become frustrated easily when listening?...................................			
22. Does your child join in rhymes/songs?..			
23. Does the child seem particularly attentive to visual cues?............................			
24. Is the child talking?...			
25. Do you understand what s/he is saying?...			

Observations by the interviewer:

(USE A SOUND LEVEL METER FOR INDICATION OF VOLUME)

Please indicate (tick) any of your observations below:

01. **Make her/him respond to mother's request (at 3 feet distance) to point at one part of her/his body in a quiet voice?**

i. **Responds** [ ]

ii. **No response** [ ]

02 **Make the child respond to mother's request (at 3 feet distance) to point at one part of her/his body without her/him seeing her lips?**

i. **Responds** [ ]

ii. **No response** [ ]

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section B

48 - 59 months old:

	Yes	No	Don't Know
26. Can s/he follow simple requests e.g. fetching water or wood from another room?.......			
27. Does s/he hear quiet speech?.......			
28. Does s/he usually watch the speaker's face and mouth?.......			
29. Does the child have to strain when listening?.......			
30. Does s/he become frustrated easily when listening?.......			
31. Do you think s/he understands better when s/he is facing you?.......			
32. Do you often have to raise your voice or gesture to gain her/his attention?.......			
33. Does the child seem particularly attentive to visual cues?.......			
34. Do you understand him when you are not watching him, e.g. when you have your back to him?.......			
35. Do other family and friends understand her/him?.......			

Observations by the interviewer:

(USE A SOUND LEVEL METER FOR INDICATION OF VOLUME)

Please indicate (tick**) any of your observations below;**

01 **Make the child respond to mother's request (at 3 feet distance) to point at one part of her/his body without her/him seeing her lips (include *susu/hair and *Mpemo/nose)?**

- **i. Responds** [ ]
- **ii. No response** [ ]

02 **Make the child imitate speech sounds with you (Tonga words with high and low frequency)?**

- **i. Speech is unclear** [ ]
- **ii. Uses signs/gestures** [ ]
- **iii. Normal speech/language** [ ]

<u>NB</u> ***Susu (hair) and *Mpemo (nose) are Tonga words with high and low frequency***

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section C

<u>60 – 72 months old</u>:

	Yes	No	Don't Know
36. Can s/he follow simple requests e.g. fetching water or wood from another room?.........			
37. Does s/he hear quiet speech?.........			
38. Does s/he usually watch the speaker's face and mouth?.........			
39. Does s/he become frustrated easily when listening?.........			
40. Do you think s/he understands better when s/he is facing you?.........			
41. Do you often have to raise your voice or gesture to gain her/his attention?.........			
42. Is the child's speech/language more difficult to understand than other children of her/his age group are?.........			
43. Does the child seem particularly attentive to visual cues?.........			
44. Do you understand her/him when you are not watching her/him e.g. when you have your back to her/him?.........			
45. Is her/his speech clear to all the family and friends?.........			

Observations by the interviewer:

(USE A SOUND LEVEL METER FOR INDICATION OF VOLUME)

Please indicate (tick) any of your observations below;

01 **Make her/him respond to mother's request to point at one part of her/his body without her/him seeing her lips?**

i. **Responds** [ ]

ii. **No response** [ ]

02 **Make the child imitate speech sounds with you (Tonga words with high and low frequency)?**

i. **Speech is unclear** [ ]

ii. **Uses signs/gestures** [ ]

iii. **Normal speech/language** [ ]

<u>NB</u> ***Susu (hair) and *Mpemo (nose) are Tonga words with high and low frequency***

APPENDIX II: IPEPA LYAMIBUZYO

MWANAKO ULAMVWA NA?

(KUSALULWA KWABANA BATAMVWI KABOTU BALA MINYAKA ILAANSI KWAMUSANU AWUMWI: 3 - 6)

<u>KUTOBELEZYA KWAMUBUZYI KUKUZUZIKIZYA PEPA LYAMUBUZYO</u>

Eelipepa lyamibuzyo lilazimpanzi ezi:

c) **Cipanzi Cakutanguna "1"**; Lwano lwamwana

d) **Cipanzi Cacibili "2"**; Tumpanzi **'A'** kuyosika kuli **'C'** Tubunga twa minyaka yamwana yakuzyalwa

Zuzikizya **cipanzi cakutanguna (1)** atumwi tumpanzi **mucipanzi cabili (2)** alimwi ulembe nzwabona

LEMBA MUBUCE ANSI AWA:

<u>MUBUCE:</u> (ZUZIKIZYA KUMAMANINO KOLI WASANDULA IMWI MIBUZYO)

Nzowabona Acikelo:

Bika, (X) acikelo cilembedwe munsi awa nzowabona atala akunvwa kwa mwana nkwacita kutobelezya jwi lyako alyabanyina:

Watobelezya cindi conse *Mane*

|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|

0 1 2 3 4 5 6 7 8 9 10

Zitondezyo zyakutamvwa: Iiyi [ ] Pepe [ ]

*(Amba kuti **Iiyi** nakuti **Pepe** akubika **X** mutubbokesi tubili tulatala awa)*

<u>Kanana abwiime bwankani eyi ansi awa:</u>

Izina lyamubuzyi: .... Izuba: ....

'MWANAKO ULAMVWA NA?':- MIBUZYO

CIPANZI CAKUTANGUNA "1" (**Ncamwana woonse**)

LWANO LWAMWANA

1. Gunzi:…………………………………… 2. Wadi:……………………………...

3. Izina lyamwana: ………………………4. Muntunzi: Mulombe [ ] Musimbi [ ]

5. Kukomena: …….(mwezi) ……(minyaka) ……..(nikwakalinzi, mwezi a munyaka)

6. Wakazyalwa lili:……………………………………………………………………

7. Izina lyacikolo:…………………………………………………………………..

(Bika X umwi mutubbokesi Twa'Iiyi', 'Pepe' naakuti 'Sizi' munsi awa. Twalumba.)

	IIYI	PEPE	SIZI
8. Kuli utamvwi na mumpuli?……………………………………………………...			
9. Mwanako waka tumbukidwe kale cikelo cilansi na (<1500g)?……………………..			
10. Mwana wakalikuyoya kabotu na nakatumbukwa?………………………………..			
11 Mwanako wakalikulangika kalicamuntondo na nakatumbukwa? …………………			
12. Mwanako wakalikupya mubili na nakatumbukwa?………………………………			
Kuti kaliwakali kupya mubili pandulula…………………………………………………			
13 Alibulwazi mbwakaciswa nwakalaalutumbu?……………………………………..			
Kuti kuli wakaciswa pandulula……… ………………………………………………...			
14. Ulamakatazyo na mukutamvwa kwamwana wako?………………………………			
15. Uyeyanga mwanako tamvwi na nakuti tamvwi kabotu?…………………………			

CIPANZI CABILI " 2"

TUBUNGA TWAMINYAKA YAMWANA YAKUZYALWA

(Sala kabunga kelede kaminyaka yakuzyalwa uzuzikizye kabunga komwe buyo)

Kabunga "A"

<u>36-47 mwezi (3 – 4 minyaka) yakuzyalwa</u>:

	IIYI	PEPE	SIZI
26. Ulatondeka kucintu namufanikisyo ulimubbuku kuti wamvwa nikwaambwa?...			
27. Ulaswiilila na kuti kalabamwi kaba lokuswiilizya twano?...........................			
28. Ulatondeka kucipanzi camubili wakwe na kuti wabuzigwa mujwi lilansi?...			
29. Ulalanga kumeso akumulomo wamuntu na ulokwambuula?.......................			
30. Sena ulijisibuyumuyumu kukuswiilizya?..			
31. Ulafwambana kubijilwa na kuti kalo kuswiilizya?..................................			
32. Ulayimba na abamwi twiimbo?..			
33. Uvuzyakulangisisya zitondezyo na mwana kuti kwambula we?.......................			
34. Ulambuula na?...			
35. Ulazimvwa na nzyaamba?...			

<u>Zilangwa amubuzyi:</u>

(Tondezya (X) nzuwabona munsi awa)

01. **Citakuti mwana acite nzyabuzigwa abanyina katondeka cipanzi camubili wakwe (meso, mpemo, susu) mujwi lilansi (musinzo wamoolu otatwe, '3ft')?**

i. **Wacita** [ ]

ii. **Tacita** [ ]

02 **Citakuti mwana atondeke cipanzi camubili wakwe (meso, mpemo, susu) ncabuzigwa abanyina katalangide mulomo wabo (musinzo wamoolu otatwe, '3ft')?**

i. **Wacita** [ ]

ii. **Tacita** [ ]

TUBUNGA TWAMINYAKA YAMWANA YAKUZYALWA

(Sala kabunga kelede kaminyaka yakunzyalwa uzuzikizye kabunga komwe buyo)

Kabunga "B"

48 – 59 mwezi (4 – 5 minyaka) yakuzyalwa:

	IIYI	PEPE	SIZI
46. Ulatumika na kwetazyubawuba mbuli kwetamanzi na nkuni komwambila kolimulimbi n'anda?...			
47. Ulamvwa na zyambwidwa ansi ansi?...			
48. Nga ulalanga na kumeso akumulomo wamuntu ulokwambula?.......................			
49. Sena ulijisibuyumuyumu kukuswiilizya?..			
50. Ulafwambana na kubijilwa kuti kalokuswiilizya?....................................			
51. Uyeya kuti umvwisisisya kabotu na kuti kakulangide?.............................			
52. Nga watola mujulu na ijwi lyako nakuti ulatondeka nkokuti wakumvwa obotu?...			
53. Uvuzyakulangisisya zitondezyo na mwana kwambuula we?.........................			
54. Ngawamumvwisisya na mwana kuti kamutalangene mbuli kuti wamufutatila?..			
55. Ulambula kamvwika na kuli bamwi mumpuli na benzinyina?.......................			

Zilangwa amubuzyi:

Tondezya (X) zuwabona munsi awa;

01 **Citakuti mwana atondeke cipanzi camubili wakwe (mpemo, meso, susu) ncabuzigwa abanyina katalangide mulomo wabo (musinzo wamoolu otatwe, '3ft')?**

- **i.** **Wacita** [ ]
- **ii.** **Tacita** [ ]

02 **Cita kuti mwana atobelezye majwi ako mbuli susu, meso, mpemo?**

- **i.** **Tazimviki nzyambuula** [ ]
- **ii.** **Ubelesya zitondezyo** [ ]
- **iii.** **Wambula kabotu** [ ]

TUBUNGA TWAMINYAKA YAMWANA YAKUZYALWA

(Sala kabunga kelede kaminyaka yakuzyalwa uzuzikizye kabunga komwe buyo)

Kabunga "C"

<u>60 – 72 mwezi (5 – 6 minyaka) yakuzyalwa</u>:

	IIYI	PEPE	SIZI
56. Ulatumika na kwetazyubawuba mbuli kwetamanzi na nkuni komwambila kolimulimbi n'anda?...			
57. Ulamvwa na zyambwidwa ansi ansi?..			
58. Nga ulanga kumeso, akumulomo wamuntu ulokwambula na?.........................			
59. Ulafwambana na kubijilwa kuti kalokuswiilizya?......................................			
60. Uyeya kuti umvwisisisya kabotu na kuti kakulangide?................................			
61. Nga watola mujulu na ijwi lyako nakuti ulatondeka nkokuti wakumvwa obotu?...			
62. Ulambula kamvwika na mbuli bamwi benzinyina belene awe mumpuli nakuti mugunzilyanu?..			
63. Uvuzyakulangisisya zitondezyo na mwana kuti kwambuula we?......................			
64. Ngawamumvwisisya na mwana kuti kamutalangene mbuli kuti wamufutatila?...			
65. Ulambuula kamvwika na kuli bamwi mumpuli na benzinyina?.......................			

<u>Zilangwa amubuzyi</u>:

(Tondezya (X) zuwabona munsi awa)

01 **Citakuti mwana atondeke cipanzi camubili wakwe (mpemo, meso, susu) ncabuzigwa abanyina katalangide mulomo wabo (musinzo wamoolu otatwe, '3ft')?**

- **i.** **Wacita** [ ]
- **ii.** **Tacita** [ ]

02 **Cita kuti mwana atobelezye majwi ako mbuli susu, meso, mpemo?**

- **i.** **Tazimviki nzyambuula** [ ]
- **ii.** **Ubelesya zitondezyo** [ ]
- **iii.** **Wambula kabotu** [ ]

APPENDIX III: BACK TRANSLATION

QUESTIONNAIRE

DOES YOUR CHILD HEAR?

SELECTION OF CHILDREN WITH HEARING PROBLEMS AGED BETWEEN

3 – 6 YEARS

INSTRUCTIONS FOR THE INTERVIEWER IN COMPLETING THE

QUESTIONNAIRE

This questionnaire has the following parts:

e) **Part 1**; History of the child

f) **Part 2**; Sections **'A'** to **'C'** Specific Age Group of the Child

Complete Part 1 and some relevant **sections** in Part 2 then write your observations

WRITE BRIEFLY BELOW HERE:

IN BRIEF: (COMPLETE AT THE END AFTER ANSWERING SOME QUESTIONS)

Your Observations on the Scale:

Put a cross (X) on the scale written below, your observations about the child's hearing following your voice and mother's:

Follows all the time *Does not follow at all*

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

0 1 2 3 4 5 6 7 8 9 10

Signs of hearing loss: Yes [ ] NO [ ]

*(Say **Yes** or **No** by putting an **X** in the appropriate box)*

In Brief, discuss the situation of this matter below here:

Name of the interviewer: .... Date: ....

'DOES YOUR CHILD HEAR?':- QUESTIONNAIRE

PART 1 **(For Every Child)**

HISTORY OF THE CHILD

1. Village:………..……………………………… 2. Ward:……………………………...

3. Name of the Child: ……………….……………….…………4. Sex: M [ ] F [ ]

5. Age: …………(months) ………….(years) ……………(local event: month/year)

6. Date of Birth:………………………………………………………………………

7. Name of School:………..……………………………..…………………………..

(Put an X in one box of 'yes', 'no' or don't know below here. Thank you.)

	Yes	No	Don't know
8. Is there a deaf in the family?………….…………………………….…………..			
9. Was your child born weighing below 500g?……………………………………….			
10. Was your child breathing normally when it was born?……………………………..			
11. Was your child appearing yellow when it was born? ..……………………………..			
12. Had your child have high temperature when it was born?………………………… If yes, please explain………………………………………………………………….			
13. Was there any disease you suffered while pregnant?……………………………….. If yes, please explain………………… ………………………………………………..			
14. Are there any problems about your child's ears?…………………………………...			
15. Do you think your child is deaf or has a hearing loss?………………………………			

Part 2

SPECIFIC AGE GROUP OF THE CHILD

(Select the Appropriate Age Group and Complete **One** Section **Only**)

Section A

<u>36-47 months old</u>:

	Yes	No	Don't Know
16. Does the child point to an object or a picture in a book if s/he hears what is said?......			
17. Does s/he listen while with others listening to stories?......			
18. Does s/he point at the part of her/his body when asked in a low voice?......			
19. Does s/he look at the eyes and mouth of a person talking?......			
20. Does s/he have difficulties in listening?......			
21. Does s/he quickly get angry when listening?......			
22. Does s/he sing with others songs?......			
23. Does the child very often look at signs when speaking with her/him?......			
24. Does the child speak?......			
25. Do you hear what the child says?......			

What the interviewer looks for:

(Show your observations by putting an X below)

01. **Make the child point her/his part of the body (such as eyes, nose, hair) asked by her/his mother while not looking at her mouth (at 3 feet distance) in a low voice?**

- **i.** **S/he responded** [ ]
- **ii.** **S/he did not respond** [ ]

02 **Make the child point her/his part of the body (such as eyes, nose, hair) asked by her/his mother while not looking at her mouth (at 3 feet distance)?**

- **i.** **S/he responded** [ ]
- **ii.** **S/he did not respond** [ ]

SPECIFIC AGE GROUP OF THE CHILD

(Select the Appropriate Age Group and Complete **One** Section **Only**)

Section B

48 - 59 months old:

	Yes	No	Don't Know
26. Can you send him/her easily to bring light things like water or firewood while instructing him/her from another house?..			
27. Does s/he hear what is said in a low voice?..			
28. Does s/he look at the eyes and lips of the person talking?............................			
29. Does he/she have difficulties in listening?..			
30. Does s/he become quickly get irritated when listening?...............................			
31. Do you think s/he understands better when looking at you?...........................			
32. Do you raise your voice or use signs in order for her/him to understand you well?...			
33. Does s/he usually look at the signs when talking to her/him?........................			
34. Do you understand the child if you are not facing her/him like you turn your back on her/him?..			
35. Does s/he speak understandably to some members of the family or friends?......			

What the interviewer looks for:

Show your observations by putting an X below;

01 **Make the child point at the part of her/his body (nose, eyes, hair) that s/he has been asked by her/his mother without looking at her (mother's) mouth (at 3 feet distance)?**

- **i.** **S/he responded** [ ]
- **ii.** **S/he didn't respond** [ ]

02 **Make the child follow the words you have said e.g. hair, eyes, and nose?**

- **i.** **What s/he says is unclear** [ ]
- **ii.** **S/he uses signs** [ ]
- **iii.** **S/he speaks well** [ ]

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section C

60 – 72 months old:

	Yes	No	Don't Know
36. Can you send her/him easily to bring light things like bringing water or firewood while instructing her/him from another house?.............................			
37. Does s/he hear what is said in a low voice?...			
38. Does s/he look at the eyes and mouth (lips) of the person talking?..................			
39. Does s/he quickly get irritated when listening?...			
40. Do you think s/he understands better when looking at you?..........................			
41. Do you raise your voice or use signs in order for her/him to understand you well?...			
42. Does s/he speak clearly like his other age mates in the family or in your village?.			
43. Does s/he usually look at signs when talking to him/her?.............................			
44. Do you understand the child if you are not facing each other like you turn your back on her/him?..			
45. Does s/he speak clearly to other family members or friends?........................			

What the interviewer looks for:

Show your observations by putting an (X) below;

01 **Make the child point at the part of her/his body (nose, eyes, and hair) which s/he has been asked by her/his mother while not looking at her (mother's) mouth (lips) at 3ft distance?**

- **i.** **S/e responded** [ ]
- **ii.** **S/he didn't respond** [ ]

02 **Make the child follow what you said, like hair, eyes, eyes, and nose?**

- **i.** **What s/he says is unclear** [ ]
- **ii.** **S/he uses signs** [ ]
- **iii.** **S/he speaks well** [ ]

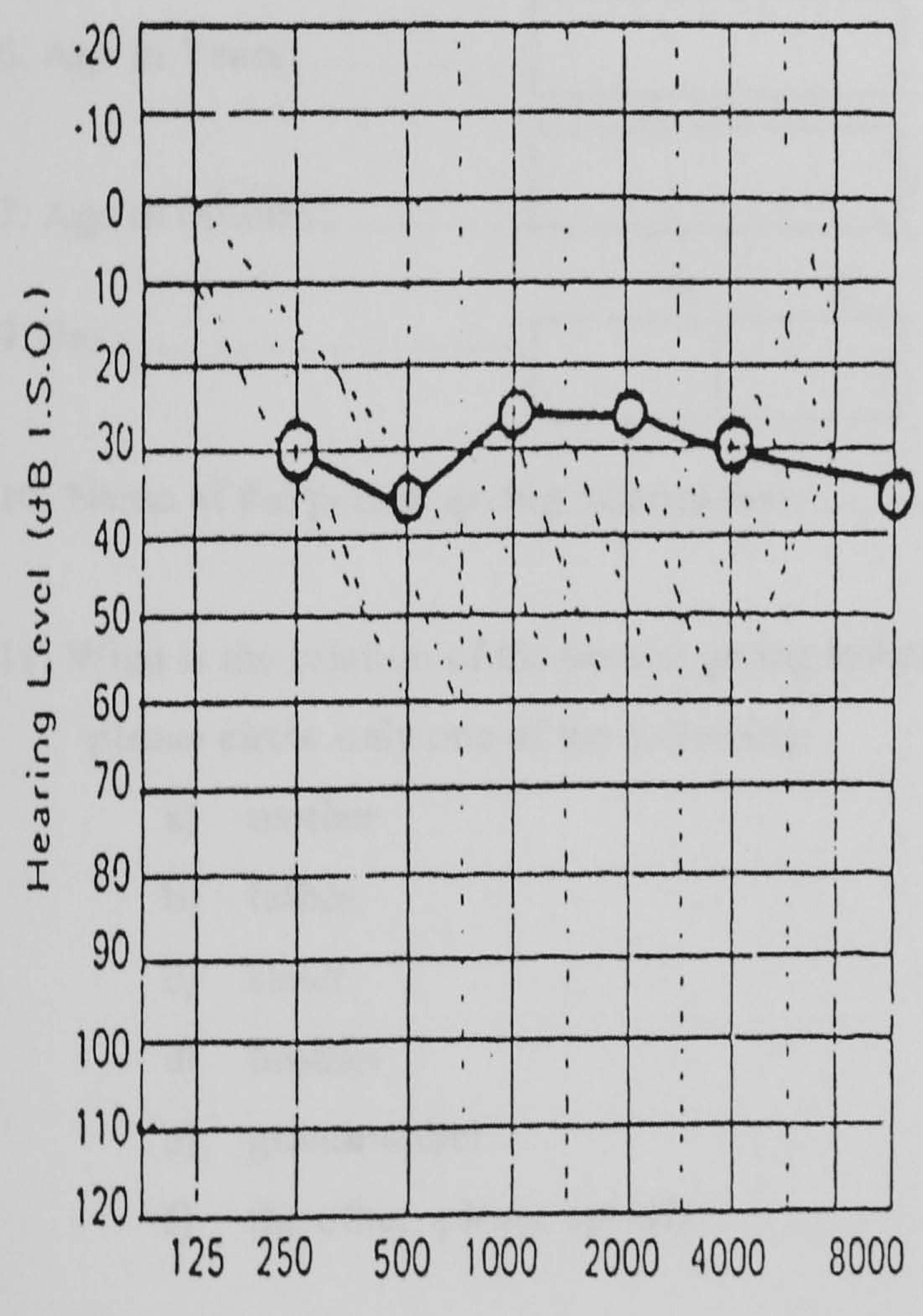
APPENDIX IV

AUDIOGRAM

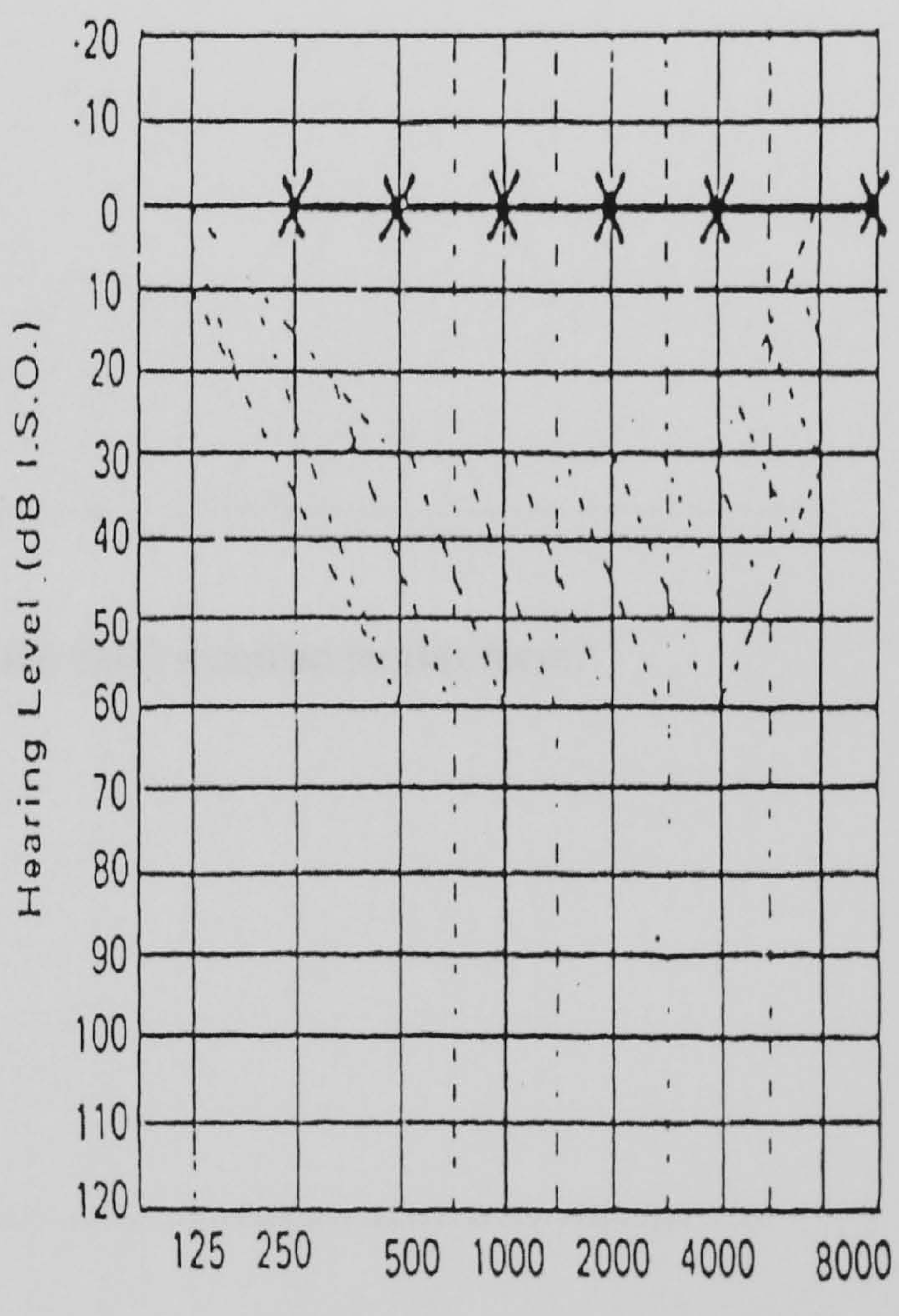
Name:………………………………..Male/Female **Case No.:………………..**

Date of Birth:………………………… **Date of Test:..…………..**

PURE TONE AUDIOMETRY



Frequency Hz.
RIGHT EAR



Frequency Hz.
LEFT EAR

Interview remarks

APPENDIX V

FORM: 1/BSHLP

ID NUMBER: [ ]

SCREENING HEARING LOSS PROJECT IN BINGA, ZIMBABWE

THE "TWO-QUESTION" RECRUITMENT TOOL FOR CHILDREN AGED BETWEEN 36 AND 72 MONTHS

---

1. Ward Name:……………………………..……….2. Village Name:…………………………………...

3. Household Name:……………………………………………………………………………………

4. Name of the child:……………………………………………………………………………………...

5. Date of birth:…………… [ ] 8. Age; local event:.. [ ]

6. Age in Years:…………… [ ]

7. Age in Months:………… [ ]

9. Sex:……………………… M [ ] F [ ]

10. Name of the person giving information: ……………………………………………………………...

11. What is the relation of the person giving information to the child recorded on this form?

please circle only one of the following:

a) mother
b) father
c) sister
d) brother
e) grandmother
f) the other, please specify; ………………………………………………………………

12. Does the child have difficulties or problems in speaking? YES [ ] NO [ ]

13. Did the child ever have puss/discharge or other problems with her/his ears? YES [ ] NO [ ]

14. <u>COMMENTS</u>:

---

15. Name of the Enumerator: …………………………16. Signature………………17. Date: ………..…

APPENDIX VI

IMPLEMENTATION PROGRAMME

Year 1: 2000 Months														
Year 1: 2000 Activities	J	F	M	A	M	J	J	A	S	O	N	D	Objectives	Indicator
Literature Review	*	*											• Reviewing literature • Writing background information • Discussing the content	1st draft of chapter 2 revised and completed by 31/03/2000
Refining Project Proposal and clarifying objectives	*	*											• Clarifying objectives of the study • Clarifying the study methods	A summary of the main project proposal produced by end of December 1999
Holding Meetings:													• Introducing the study to the local leadership, government and other institutions in Binga • Selecting study wards	The project approval by the full council (Binga Rural District Council) endorsed by April 2000
• Binga Rural District Council with councillors			*											
• Ministry of Health and Education (2)			*	*	*									
• Ward/Village communities (4)			*	*	*									
Recruitment of subjects:													• Compiling a sampling framework • Training enumerators • Recruiting subjects into the study	The demographic data compiled and made available end of August 2000
• Training enumerators 12 villages (1 each x12 volunteers)					*									
• Conducting a survey					*	*								
• Enrolling subjects into the study						*								
Translating questionnaire screen into Tonga:						*							• Pilot testing the screen • Printing the screen	2,500 of the "questionnaire" screen printed for use in the field end of November 2000
• Pilot testing screen						*								
• Refining screen							*							
• Printing the screen							*							
Training 6 screeners: a) 3 RTs b) 3 Teachers						*	*						• Training interviewers on using the screen	6 interviewers trained for 5 days and their competencies assessed in the field by end of December 2000

Administering the "Questionnaire" screen							*	*	*	*	*		• Conducting interviews	834 children screened by November 2000
Pure-tone audiological screening							*	*	*	*	*		• Pure-tone screening subjects	10% (n=834) study sample re-screened by December 2000
Writing a field report												*	• To write an annual report	An annual report finalised and sent to funders by end of December 2000
Year 2: 2001 Months														
Year 2: 2001 Activities	J	F	M	A	M	J	J	A	S	O	N	D		
Training workshops for pre-school teachers and village community workers on screening HL in children	*	*	*	*									• To screen hearing loss in children by using a questionnaire screen	Children accurately screened by community workers in the villages by June, 2001
Holding 4 workshops for primary school teachers on screening HL in children					*	*	*	*					• To audiological assess the screened population	10% of the screened 72 month-olds assessed for school placement by September, 2001
Testing inter-user reliability of the "Questionnaire" screen									*				• To re-screen children by using a questionnaire	131 children retested by end of October 2001
Collaboration visit (in-service-training) to Jairos Jiri Ear Laboratory Centre										*			• To attend a collaboration meeting on screening hearing loss in developing countries	Exchange visit report produced by November 2001
Writing a field report											*	*	• Writing an annual report	An annual report finalised by end of December 2001
Year 3: 2002 Months														
Year 2: 2001 Activities	J	F	M	A	M	J	J	A	S	O	N	D		
Evaluating the training intervention					*	*	*	*	*				• Evaluating effectiveness of training partners	Enrolling deaf children into local schools
The study documentation	*	*	*	*	*	*	*	*	*	*	*	*	• Writing the thesis	Production of the thesis

APPENDIX VII

ONE DAY TRAINING PROGRAMME FOR 21 VCWs

VENUE: **BINGA DISTRICT HOSPITAL**

DATE: **01/05/00**

AIM:
To enrol children aged between 36 and 72 months in selected 5 wards in Binga

OBJECTIVES:

- To list ways of carrying out surveys
- To discuss problems associated with carrying out of surveys
- To role play interviewing informants
- To practise interviewing and recording information by use of the survey forms

TIME TABLE FOR ONE-DAY TRAINING WORKSHOP FOR 21 VCWs

TIME	TOPIC	CONTENT	TRAINING KEY POINTS	OBJECTIVES	FACILITATOR
08:00 – 10:00	Interviews	Surveys: Carrying out interviews, asking questions techniques	Demographic data (to estimate number of target group in an area). For planning information	• To list ways of carrying out surveys • To discuss problems associated with carrying out of surveys	• The District Administrator • Researcher
10:00 – 10:30	B	R	E	A	K
10:30 – 13:00	At Risk Questions	At Risk Questionnaire. Information it collects	How to interview informants and recording	• To role play interviewing informants	• Researcher • RT (Binga Hospital)
13:00 – 14:00	L	U	N	C	H
14:00 – 16:00	RECAP and closing	Recording information	Accuracy in recording information	• To practise interviewing and recording information by use of the survey forms	• Researcher • RT • Remedial tutor co-ordinator (Ministry of Education)

Notes:
VCW = Village Community Worker; RT = Rehabilitation Technician

APPENDIX VIII

FIVE-DAY TRAINING PROGRAMME FOR SCREENERS

VENUE: **BINGA DISTRICT HOSPITAL**

DATE: **01 to 05 June 2000**

AIM:
To screen hearing loss in children aged between 36 and 72 months in selected 5 wards in Binga

OBJECTIVES:

- To identify hearing loss in children
- To acquire skills of assessing hearing acuity in children
- To conduct a hearing screening exercise in the fieldwork

TIME TABLE FOR FIVE-DAY TRAINING WORKSHOP FOR SCREENERS

TOPIC	TRAINING POINTS	KEY RESULTS	DAY/ TIME	FACILITATOR
Welcoming participants and official opening	- registration and officiating the workshop	- official opening - registration	D-1: AM	District Administrator and Chief Executive Officer
Introduction	- set the scene	- outline of the purpose of the workshop	D-1: AM	Researcher
Hearing mechanism in children	- anatomy and physiology of the ear - perception of sound	- describe the hearing mechanism in children - list types of hearing loss - explain levels of hearing loss and their effects in communication	D-1: PM	Audiologist
Aetiology of hearing loss and ear pathology in children	- congenital and acquired diseases and conditions	- describe causes of hearing loss and effects of ear diseases in children	D-2: AM	Audiologist
Hearing loss and its effects in communication	- communication disabilities	- list problems which come as a result of hearing loss in children	D-2: PM	Remedial Tutor
Low cost hearing screen	- techniques of designing a hearing screen for children	- construct a questionnaire hearing screen	D-3: AM	Researcher
Screening hearing loss in children	- techniques of assessing hearing acuity in children	- identify hearing loss in children	D-3: PM	Audiologist and Provincial therapist
ECEC Policy on the education of the hearing-impaired children	- rehabilitation of deaf children - monitoring and evaluation	- integration of deaf children at pre-school level	D-4: AM	ECEC Supervisor and Remedial Tutor
Screening hearing loss in children	- techniques of assessing hearing acuity in children	- identify hearing loss in children - field work 1	D-4: PM	Researcher
Screening hearing loss in children	- techniques of assessing hearing acuity in children	- identify hearing loss in children - field work 2	D-5: AM & PM	Researcher

APPENDIX IX

ONE DAY TRAINING PROGRAMME FOR SCHOOL HEADS AND DISTRICT OFFICERS IN BINGA ON HEARING LOSS IN CHILDREN

VENUE: **BINGA DISTRICT HOSPITAL**

DATE: **29/03/01**

1.0 BACKGROUND

The training workshop aims to raise awareness on the prevalence of hearing loss in the school going age group in Binga, which seems to be high and is estimated at 6-10% when cases of temporary hearing loss (otitis cases of mild to moderate hearing loss levels) are considered. The workshop also, aims to persuade professionals to consider the needs of the hearing impaired. The professionals are to be convinced that they need to include in their plans the rehabilitation of the hearing impaired children living in their communities. The training programme should introduce a simple method of screening hearing loss in the target population (36-72 month-olds) by using a low cost screening tool (a questionnaire screen).

2.0 OBJECTIVES

At the end of the workshop participants should be able to:

1. estimate the prevalence of hearing loss in children
2. describe the process of the hearing mechanism in children
3. explain the aetiology of hearing loss and ear pathology in children
4. describe the levels of hearing loss and their effects in communication
5. construct a simple hearing screening questionnaire for children aged 36-72 months
6. conduct a screening exercise by using a questionnaire screen
7. design a 12-month rehabilitation programme targeting the pre-and school going age group

TIME TABLE FOR THE ONE DAY TRAINING WORKSHOP FOR SCHOOL HEADS AND DISTRICT OFFICERS IN BINGA

TOPIC	TRAINING POINTS	KEY RESULTS	TIME	FACILITATOR
Welcoming participants and official opening	- registration and officiating the workshop	- official opening - registration	09:30-10:00	DA/CEO
Introduction	- set the scene	- outline of the purpose of the workshop	!0:30-11:00	Researcher
Prevalence of hearing loss in children	- literature estimates in Southern Africa - estimates in Zimbabwe - estimates in Binga	- estimate hearing loss in local communities in Binga	11:00-11:30	Researcher
Hearing mechanism in children	- anatomy and physiology of the ear - perception of sound	- describe the hearing mechanism in children - list types of hearing loss - explain levels of hearing loss and their effects in communication	11:30-12:00	Researcher
Aetiology of hearing loss and ear pathology in children	- congenital and acquired diseases and conditions	- describe causes of hearing loss and effects of ear diseases in children	12:30-13:00	DNO/Community Sister
Hearing loss and its effects in communication	- communication disabilities	- list problems which come as a result of hearing loss in children	14:00-14:30	Remedial Tutor
Low cost hearing screen	- techniques of designing a hearing screen for children	- construct a questionnaire hearing screen	14:30-15:30	Researcher
Screening hearing loss in children	- techniques of assessing hearing acuity in children	- identify hearing loss in children	15:30-16:00	Rehabilitation Technician
Rehabilitation/ intervention for hearing impaired children	- rehabilitation programme - implementation period - monitoring and evaluation	- produce action plans	16:00-16:30	Remedial Tutor

Notes:

DA = District Administrator

CEO = Chief Executive Officer

DNO = District Nursing Officer

APPENDIX X

ONE DAY TRAINING PROGRAMME FOR PRE-SCHOOL TEACHERS ON HEARING LOSS IN CHILDREN

VENUE: BINGA REST CAMP

DATE: 30/05/01

1.0 BACKGROUND

The training workshop aims to raise awareness on the prevalence of hearing loss in the school going age group in Binga, which seems to be high and is estimated at 6-10% when cases of temporary hearing loss (otitis cases of mild to moderate hearing loss levels) are considered. The worshop also, aims to persuade the professionals to consider the needs of the hearing impaired children in their routine programmes. The professionals are to be convinced that they need to include in their plans the rehabilitation of the hearing impaired children living in their communities. The training programme should introduce a simple method of screening hearing loss in the target population (36-72 month-olds) by using a low cost screening tool (the "Questionnaire" screen).

3.0 OBJECTIVES

At the end of the workshop participants should be able to:

1. estimate the prevalence of hearing loss in children
2. describe the process of the hearing mechanism in children
3. explain the aetiology of hearing loss and ear pathology in children
4. describe the levels of hearing loss and their effects in communication
5. construct a simple hearing screening questionnaire for children aged 3-6
6. conduct a screening exercise by using a questionnaire screen
7. design a 12-month rehabilitation programme targeting the pre-and school going age group

TIME TABLE FOR ONE-DAY TRAINING WORKSHOP FOR PRE-SCHOOL TEACHERS

TOPIC	TRAINING POINTS	KEY RESULTS	TIME	FACILITATOR
Welcoming participants and official opening	- registration and officiating the workshop	- official opening - registration	09:30-10:00	DA/CEO
Introduction	- set the scene	- outline of the purpose of the workshop	!0:30-11:00	Researcher
Hearing mechanism in children	- anatomy and physiology of the ear - perception of sound	- describe the hearing mechanism in children - list types of hearing loss - explain levels of hearing loss and their effects in communication	11:00-11:30	Researcher
Aetiology of hearing loss and ear pathology in children	- congenital and acquired diseases and conditions	- describe causes of hearing loss and effects of ear diseases in children	11:30-12:00	DNO/Community Sister
Hearing loss and its effects in communication	- communication disabilities	- list problems which come as a result of hearing loss in children	12:00-13:00	Remedial Tutor
Low cost hearing screen	- techniques of designing a hearing screen for children	- construct a questionnaire hearing screen	14:00-14:30	Researcher
Screening hearing loss in children	- techniques of assessing hearing acuity in children	- identify hearing loss in children	14:30-15:00	Rehabilitation Technician
ECEC Policy on the education of hearing impaired children	- rehabilitation programme - implementation period - monitoring and evaluation	- produce action plan	15:30-16:00	ECEC Supervisor

Notes:

CEO = Chief Executive Officer

DNO = District Nuirsing Officer

ECEC = Early Childhood Education and Care

APPENDIX XI

PRE-AND POST-WORKSHOP QUESTIONNAIRE

SCREENING AND SERVICE PROVISION FOR HEARING IMPAIRED CHILDREN AGED 3-6 IN BINGA

This questionnaire is filled in by you the workshop participant at pre-and post-workshop to get your perceptions on screening and service provision for hearing impaired children in your community in Binga.

There is no incorrect or correct answer, so please fill this questionnaire as honestly as possible all questions below.

Thank you.

1.0 General information:

District:...Ward you are working in:......................................

Your institution: ☐ school ☐ hospital ☐ other gvt ☐ ngo ☐ other specify
(Please tick)

Your profession: ☐ teacher ☐ health ☐ s/work ☐ c/dv ☐ other specify
(Please tick)

How many of your staff is specialised trained in hearing impairment? ☐

2.0 Hearing impairment

What do you associate the word hearing impairment with?

....

....

A child with a hearing loss means that s/he has a problem with ....

....

I think problems faced by a child aged 3-6 who has a hearing loss are:

a)..

b)..

c)..

d)..

I understand that the term hearing impairment means..

....

Professionals, the community and others could help a child aged 3-6 with hearing impairment in the following ways:

a)..

b)..

c)..

d)..

e)..

I think the pre- and school going age group children with hearing impairment could be helped as follows:

a)..

b)..

c)..

d)..

e)..

I think that the role of my institution towards hearing impaired children is to do the following tasks:

a)..

b)..

c)..

d)..

e)..

At the moment children with hearing impairment are rehabilitated/helped as follows in my community:

a)..

b)..

c)..

d)..

e)..

In the past 12 months I met about [ ] children with hearing impairment during my routine work.

Concerning the identification of hearing impaired children, I think it * **IS** or * **NOT** important to screen children aged 3-6 to identify hearing impaired children (*delete the inappropriate word in bold).

Please, support your choice of the statement above ....

....

I, also, think that it *IS or *NOT necessary to committee our meagre resources in the rehabilitation programmes of the hearing impaired children *(* delete the inappropriate word in bold).*

Please, support your choice of the statement above ....

....

3.0 Community attitudes towards people with disability

Please, place an X along the scale below; 0 means the community is very negative and 10 is being very positive towards people living with disabilities for example the deaf.

Very negative Very Positive

0.........2.........3..........4.........5.........6.........7.........8.........9.........10

How many children aged between 3-6 were enrolled/served by your school/or institution in the year 2000?

How many children aged between 3-6 are enrolled/served by your school/or institution in the year 2001?

I estimate that about ....general and specific programmes in my catchment area community serve % of children with hearing impairment.

But my institution serves about ....% of children with hearing impairment in my catchment area community.

However, I would like to committee myself and to get involved in helping/rehabilitating children with hearing impairment during and after my routine work at my institution or within my catchment community within the coming 12 months as follows:

a)...

b)...

c)...

d)...

e)...

4.0 Workshop expectations

Please, list your expectations at the workshop below:

a)...

b)...

c)...

d)...

e)...

How do you think you intend to use the knowledge you will gain from the workshop?
Please, in brief here below outline your action plan towards the rehabilitation of the hearing impaired children in your catchment area as from May 2001 to May 2002. Follow an example given below:

The Rehabilitation of Hearing Impaired Children Action Plan 2001 – 2002

	Activity	**Period**	**Responsible Person**	**Key Result**
E.g.	Awareness campaign	May-June 2001	School Head	- 3 meetings with the local leadership - # hearing impaired children identified
a)				
b)				
c)				
e)				
e)				

Please, also indicate in two boxes (Yes or No) provided below if you agree to participate in a follow-up evaluation exercise on your action plan you outlined above after a full 12 months implementation period?

I give my consent: ☐ Yes ☐ No

Sign here:.. Date:...............................

The workshop organisers wish to thank you very much for your time in filling in this questionnaire.

NB. *You are assured that the information given in this questionnaire will be treated strictly in confidence.*

Sd/sd

APPENDIX XII:

Follow-up Data Collection Questionnaire

QUESTIONNAIRE ON THE KNOWLEDGE, ATTITUDE AND PRACTICE OF SERVICE PROVIDERS IN INCLUDING HEARING IMPAIRED CHILDREN IN MAINSTREAM EDUCATIONAL ACTIVITIES IN BINGA.

INTRODUCTION

I am carrying out a study to investigate knowledge, attitudes and practice of service providers towards the inclusion of hearing impaired children in mainstream educational activities. In view of this, it is very important for me to hear from people who have experience of working in Education or Primary Health Care like you, so that I get your views about including deaf children in educational activities. I would appreciate it if you could, please, spare some of your time to answer this questionnaire. There are no right or wrong responses, just put down your true views. **Your views will be held in utmost confidence**. For **confidentiality** reasons, no names are required on this questionnaire.

Please tick the spaces that apply to you in the questions below.

ID No. [ ]

1. AGE:
   20-30 [ ]
   31-40 [ ]
   41-50 [ ]
   51-60 [ ]
   61+ [ ]

2. SEX: Male [ ] Female [ ]

3. Department you are working in:
   Government [ ]
   NGO [ ]
   Other [ ] Specify: ....

4. OCCUPATION:
   Head [ ]
   Deputy Head [ ]
   Pre-school Teacher [ ]
   Nurse [ ]
   Rehab. Technician [ ]
   Development Worker [ ]
   Other [ ] Specify: ....

5. Do you know of any child with hearing problems at your workplace?
   [ ] Yes
   [ ] No
   [ ] Don't know

6. How did you become aware that the child has a hearing problem? Please tick the box **most relevant** to you.
   [ ] child continuously rubbed his/her ears.
   [ ] child had pus coming out of his/her ears.
   [ ] child always asked me to raise my voice when talking to him/her.
   [ ] none of the above.
   [ ] other. Please specify..

7. Had this child previously complained of hearing difficulties?
   [ ] Yes
   [ ] No

[ ] Don't know

8.Which of these best describes the child's hearing problem? Please tick **the most** applicable box.

[ ] child complains of painful ears
[ ] child has ear discharge and/or pus coming out of the ears
[ ] child cups ears when I am speaking with him/her
[ ] child cannot hear anything I am saying to him/her
[ ] other. Please specify..

9. Do you think the child does not hear? Please tick the box, which is applicable.

[ ]Yes
[ ] No
[ ] Don't know

10.What do you think are the causes of hearing impairment in any child? Please tick **the most** applicable box.

[ ] diseases
[ ] evil spirits
[ ] bewitchery
[ ] accidents
[ ] none of the above
[ ] other. Please specify..

11. The child's hearing impairment can be prevented by: Please choose **one**.

[ ] pouring some drops of cooking oil in the child's ears
[ ] seeking medical attention
[ ] visiting traditional healers to cast lots
[ ] pouring some drops of traditional medicine in the child's ears
[ ] other. Please specify..

12. Are you aware of any organisation that can help deal with the child's hearing problem?

[ ] Yes
[ ] No
[ ] Don't know

13. How did you feel when you discovered the child's hearing problem? Please tick the appropriate box.

[ ] worried
[ ] pleased
[ ] indifferent
[ ] did not consider it a problem
[ ] other. Please specify..

14. Do you have any **worries** about the child's general behaviour?

[ ] Yes
[ ] No
[ ] Don't know

15. Do you have worries about the child's **progress** at school?

[ ] Yes
[ ] No
[ ] Don't know

16. I believe the best setting to take care the hearing-impaired child is: choose the **most appropriate** to you

[ ] in the ordinary school setting in Binga
[ ] at a special school outside the District
[ ] at the hospital

[ ] at a children's home

17. Do you assign similar duties to the hearing impaired children and those without?
    [ ] Yes
    [ ] No
    [ ] Don't know

18. The hearing impaired child finds the task in the school....... Please choose **one**
    [ ] easy to do compared with a hearing child
    [ ] too difficult compared with a hearing child
    [ ] no difference compared with a hearing child

19. Enrolling hearing-impaired children at school in Binga is:
    [ ] very important
    [ ] not important at all
    [ ] does not make any difference
    [ ] other. Please specify...

20. Do you think **hearing impairment** in children can limit their participation in community life?
    [ ] Yes
    [ ] No
    [ ] It depends. Please explain...

21. What type of **career training** do you think is beneficial to hearing-impaired children?
    [ ] academic orientated
    [ ] vocational orientated
    [ ] no training will do them any good

22. **When** should this training start, if any?
    [ ] as early as possible
    [ ] when they finish secondary school
    [ ] when the are adults
    [ ] they should not be trained at all

23. What do you think should be **done** to improve the welfare of hearing-impaired children? Please tick the **most applicable** box to you
    [ ] include them in special schools
    [ ] be sympathetic to them
    [ ] involve them in all mainstream activities
    [ ] nothing at all

24. Please indicate how long you spend with the hearing impaired child, supervising him/her compared to a hearing child. Please tick the **most appropriate** to you.
    [ ] the same time as the hearing one
    [ ] twice compared to the hearing one
    [ ] three times compared to the hearing one
    [ ] four times compared to the hearing one
    [ ] five times compared to the hearing one
    [ ] I have not considered this aspect.

25. **Who**, do you think, should be involved in order to improve the welfare of hearing-impaired children, if any?
    [ ] parents only
    [ ] professionals only
    [ ] parents and professionals only
    [ ] all people in the community

26. What action did you take when you first learnt of the child's hearing problem?
    [ ] sent the child home for ever

[ ] sent the child to the clinic/hospital
[ ] did nothing at all
[ ] other. Please specify...

27. What measures do you take to **treat** the hearing impairment in children?
[ ] send them for further assessment
[ ] send them to be fitted with a hearing aid
[ ] send them for traditional treatment
[ ] nothing because it cannot be treated at all
[ ] other. Please specify...

28. What problems do you encounter when doing this?
[ ] financial problems for transport
[ ] other professionals do not co-operate
[ ] I do not encounter problems at all
[ ] other. Please specify...

29. Was any hearing-impaired child recommended for a hearing aid?
[ ] Yes
[ ] No
[ ] Don't know

30. If yes, was the child fitted with one?
[ ] Yes
[ ] No
[ ] Don't know

31. If yes, does the child frequently use the fitted hearing aid?
[ ] Yes
[ ] No
[ ] Don't know

32. What roles do hearing-impaired children have in your work place?
[ ] they do no work at all
[ ] they are sent away
[ ] they are treated the same as other children
[ ] they are always given preferential treatment

33. Do you treat hearing-impaired children the **same** as you treat hearing children?
[ ] Yes
[ ] No
[ ] It depends. Please explain...

34. What steps do you take to ensure hearing-impaired children **are not** exposed to risks e.g. abuses or environmental dangers?
[ ] give them necessary information
[ ] ensure they are not alone at any given time
[ ] talk to parents
[ ] I cannot communicate with them
[ ] other. Please specify...

35. At which level do you communicate with hearing-impaired children? Please tick the box that is applicable.
[ ] at a superficial level e.g. what they want to do
[ ] at a creative level e.g. how they can change an activity
[ ] at a deep level e.g. what do they worry about
[ ] Not at all.

36. How do you **communicate** with them? Please tick **one** most applicable.

[ ] using Sign language
[ ] using verbal communication
[ ] using gestures
[ ] I do not communicate with them at all

37. How are the hearing-impaired children's responses?
[ ] they enjoy a lot
[ ] they become irritated
[ ] there is no difference at all
[ ] other. Please specify...

38. Do you have anything else to say, which you feel **has not** been covered here about hearing-impaired children? Please write in the space below.
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***** Thank you for sparing your time to answer this questionnaire. *****

APPENDIX XIII

Follow-up Data Collection Focus Group Guide Questions

GUIDELINE FOR FOCUS GROUP DISCUSSION WITH PRE-SCHOOL TEACHERS AND VILLAGE COMMUNITY WORKERS.

INTRODUCTION

I am carrying out a study to investigate knowledge, attitudes and practice of service providers towards the inclusion of hearing impaired children in mainstream educational activities. In view of this, it is very important for me to hear from people who have experience of working in Education or Primary Health Care like you, so that I get your views about including deaf children in educational activities.

1. I want you to tell me about deaf children in your area.
- Are there any deaf children in your area?
- Do deaf children do the same things as hearing children?

2. What do you think are the causes of deafness?
- How do you think the deafness in children can be prevented?

3. Should deaf children be sent to school?
- Should they be sent to special schools or regular Binga schools?
- What should be done to improve deaf children's welfare?

4. How did you feel when you first discovered there was a deaf child in your class or school?
- What is the deaf child's progress at school?

5. How do you communicate with deaf children?
- Does your communication remain rather superficial or it can go deeper?

6. What communication responses do you get from the deaf children?

7. What steps did you take when you discovered children's hearing problems?

8. What steps did you take to treat the deafness in children?

9. Is there anything you would like to say about deafness in children?

Thank you for sparing me your time.

APPENDIX XIV

ONE OF THE FOCUS GROUP DISCUSSION CONDUCTED BY FIELDWORKER NUMBER 2 (F2)

ENGLISH VERSION OF MANJOLO FGD II **GROUP:** Untrained Pre-school Teachers

VENUE: Manjolo Pre-school Centre **DATE**: 15.05.02

PARTICIPANTS: MAN201; MAN202; MAN203; MAN204

F2: I welcome you all to this discussion we have, of looking at hearing-impaired children. My name is ... I am doing my study for my Masters. I am carrying out a study to investigate knowledge, attitudes and practice of service providers towards the inclusion of hearing impaired children in mainstream educational activities. In view of this it is important for me to hear from people who have experience of working in Education or Primary Health Care like you, so that I get your views about including deaf children in educational activities. I want you to tell me about deaf children in your area. Are there any deaf children in your area?
MAN202: Yes there are.
MAN201: Yes there are in our area.
MAN203: Yes there deaf children in our areas. (MAN204HS nods in agreement).
F2: Do deaf children do the same things as hearing children? Let us say in play activities, let us say the work they do, do they do different work from hearing ones?
MAN201: Um, yes the things they do are different from hearing ones, but for others, if you show him that others are doing it like this, he also does albeit through signs.
MAN202: As for me, the child is there, although it she is still young to work, as she is 3 years old. Because of deafness, she likes staying with the mother. But now I try to encourage the mother to bring the child so that I try speaking to her using signs.
F2: How about play activities?
MAN202: Um, she does some play activities like cooking for each other. She does it if she sees others cooking in small tins, then she also does what? She also fetches some water and cooks. Even in watering the garden, like these gardens that are fashionable these days, she also takes a small tin and waters.
F2: What about you, sir?
MAN203: The one I know has also not come to the pre-school, but work that they do is different because when others do, she looks for signs only. But to do this work, she does it differently from others, because she does not understand the instructions given to others to do.
F2: But if you explain to her does she follow what others do?
MAN203: She follows some, but others she does not, because of her hearing problem.
P: Okay, but the things they are shown to do is the same to all?
MAN203: Yes the things are the same, but due to deafness she does it differently from others.
F2: Thank you. What do you think are the causes of deafness?
MAN201: I think what causes deafness is that, because many children start by having pus come out. Pus comes out from the ears, then that child, some start suffering while they are still very young. Then as they grow older, the nerves to the ears no longer function properly.
F2: Thank you, we have heard about the hearing nerves, how about others?
MAN202: Some are born not speaking. The mother tests this by making noise on the pillow. If she discovers that the child does not speak, nor does she respond to the noise, then she suspects the child of deafness.
F2: That is very interesting information. What really begins when the child is born? Is it speaking or hearing?
MAN202: It is hearing. When the baby is born the mother listens for the first noise the baby makes. Then while the baby is asleep, the mother makes noise on the pillow. Then she will confirm that the baby surely does not hear.
F2: What will the mother be looking for up to the extent of making noise on the pillow?
MAN202: Making noise on the pillow will be confirmation of whether the baby hears or not.
F2: Hey, so we have specialists in the community?
ALL: Laugh.

F2: So how do you think deafness in children can be prevented? Maybe we had not yet finished, what do you think?
MAN203: On deafness, there are times when you really want to see that the child does not hear. You will call him, but he will be looking aside. If the child is looking this side, and you call him, he will still be looking that same direction, as he will be hearing nothing. But if you show him through signs that is when he will realise that you are talking.
F2: So what causes deafness?
MAN203C the nerves in the ears cause it.
F2: So deafness is caused by damaged nerves in the ears or that the child is born deaf? That is all we think of?
ALL: Nod
F2: Okay, how do you think the deafness in children can be prevented?
MAN204: Here deafness in children should be prevented through sending them to hospitals, or through some other help that can aid their hearing.
F2: Like which help? Could you give us an example?
MAN204: Um, there are certain objects that are put in the pocket, charged with solar. These objects, when you speak, amplify your voice.
F2: Okay, hearing aids? (MAN203HS nods head). Thank you very much, what do you others think?
MAN203: On deafness you mean?
F2: Yes, on how we can prevent it. This one talked about sending children to hospitals for treatment, as well as providing them with hearing aids. What do you think we can do for them in order to prevent deafness?
MAN203: I think if the child is deaf, it is better the child is sent to the doctor. Then the doctor, will examine what is troubling his ears.
F2: What about you, madam?
MAN201: I think what causes deafness in children, being helped. But I think I have not come across a child who was born deaf. Others, especially, will be hearing while they are young, but deafness comes about as a result of chronic otitis media.
F2: So how do you think we can prevent it then?
MAN201: As for that one, the only solution is sending them to the hospital. To the hospital.
F2: It appears you are all agreeing that sending children to hospital for treatment is what should be done.
ALL: Hmmm. (agreeing).
F2: Should deaf children be sent to school?
MAN201: Yes they should be sent to school. They really should, so that they go to school. If the teacher is talking near the blackboard, or giving signs, isn't the teacher will be giving him signs?
F2: What do others say?
MAN202: They should go to school, because if you neglect the child because he is deaf, he does not speak, then he will remain like that, because you say does not speak. But if he goes to school it is better that he gets educated.
F2: What do you think, sir?
MAN204: It is really good to send them to school. There are some people who are able to help them. Like I said before, if they give them hearing aids, then they also have some work they are able to do.
F2: Thank you. Should they be sent to special schools of the deaf or any regular schools in Binga?
MAN201: I think to special schools. To special schools because as there is a teacher specifically allocated to teach them using signs. The teacher uses sign language only.
F2: Okay, what do others think?
MAN202: They should go to special schools, but like in our district such schools are a problem. They are not there. There was supposed to be one class here at Manjolo, but then the teacher left. So then we are unable to untie the problem. We will be sending them together with those who hear. Because there is no teacher specifically for the deaf class and that of the hearing. There is none, so we mix only, with those who hear.
MAN203: I think the same way. They should be sent to some other place, specifically for the deaf. But as we are here in Binga, there is no special school for those who cannot hear and speak, because of not having helpers, who can help deaf children, and also not having hearing aids.
F2: Since we do not have such special schools what should be done?
MAN202: We want a special school to be opened.
F2: Thank you. How about in the homes now? Are we saying that deaf children live in one home alone?
MAN201: No, they stay differently.

F2: Do they stay alone as deaf children or they mix with hearing ones?
MAN201: Um, they mix with hearing people. When they mix like that, those in the home, even their friends, play using signs and gestures only. They first alert him, and then they show him what they are doing. He observes what is being done, and he then does it also.
F2: That is why I am asking, because I heard you saying they should be sent to a special school for the deaf. Are you saying deaf children should be selected and put together?
ALL: Surely no.
F2: Is that what we are agreeing or you are saying since they already mix with the hearing, their situation must not change when they go to school?
MAN202: Yes, it must not change.
F2: This is the purpose of the discussion. I do not know how you view it, I am not saying what you are saying is wrong. Like I said before, all your views are very correct. What should be done to improve deaf children's welfare?
MAN203: What should be done is getting help from those in other places, or from those who are able to help with hearing aids.
F2: Is that all?
MAN202: Those who have the expertise about the development of deaf children, like a teacher trained in that field, one who knows to show how six, for example, is written, using sign language. Maybe we can be helped.
F2: In other words you are saying professionals, with the knowledge about the welfare of these children should help?
ALL: Yes.
F2: Thank you very much. You said earlier on that deaf children are there in your areas, how did you feel when you first discovered there was a deaf child in your area or at school?
MAN204: I was deeply disturbed, because if someone is deaf, that becomes a problem. Because if he is deaf, he won't hear anything that is being said. This becomes a problem to us, of finding how we can help since we do not have the means.
MAN202: I really feel pity because a child who is deaf, you may be talking, but he cannot hear. Even in thoughts we become different, especially if you do not know how to sign. You will continue calling him, yet he does not hear you. So I feel pity for such a person.
MAN201: My response is the same as the last speaker.
F2: Thank you. To those children who are at school that you know of, what is that child's progress at school?
MAN202: The one that I know passed very well his Grade Seven. Victor, the son to Siakulipa. There was help in that there was a teacher, who was teaching them. He passed his Grade Seven, but due to our lack of knowledge as to where he can be sent to learn, where there are deaf counterparts. As of now the child is at home, he didn't go anywhere.
F2: How about you, sir? Don't you know of any?
MAN203: He is the same child mentioned by the last speaker. That child had good progress, because there was help from one who had knowledge about children. He was doing the right thing, just like his hearing counterparts. He had all that he needed in order to hear what the teacher is saying.
F2: Now let us come to communication. How do you communicate with them when you meet them?
MAN204: There are difficulties in communicating with deaf children. It takes a long time for you to understand each other. At times you try to speak aloud, thinking maybe he will hear. But the reply you get, you find that it is not the answer you wanted him to give, because of deafness. Then such a child I really try to look at his problem and ask if there could be no solution to his problem at home, or which we can help ourselves. Then I find that there is nothing we can do because in our area we have nothing.
F2: In other words how do you communicate with them? Do you speak like others do, or do you use signs?
MAN204: I start off speaking to him. If I discover that he does not understand what I am saying, then I use signs and gestures so that we are at the same level of understanding, as it should when we are communicating.
MAN201: Surely a deaf child from birth right up to the time he goes to pre-school, will mean that he does not hear. So that child, whatever you do, you use signs only. You use signs only to tell him to do this.
F2: So you communicate with him using signs only?
MAN201: Yes.
MAN202: As for me, I use signs only. When we meet I say "hee hm hm hm" (demonstrates using gestures). Then he will understand, as he speaks like "eeee wee wee wee" Then I will use signs. When he looks at me I will then know that he has understood.

F2: Does your communication remain at a superficial level or it can go deeper, like finding out what they want or how they feel? How do you communicate with them?
MAN202: If you meet him, like at the pre-school, and he wants to drink some water near, he will come near you and touches you. Then you will ask what he wants. He will say he wants some water. Then you take a cup, get some water and give him to drink. After that you hear "hee hee" (claps hands) thanks you and goes to sit down.
F2: In other words you are saying that you communicate at a deep level?
MAN202: We really sit down at a deep level so that I get to know whether he understands when I am talking or he understands better using signs.
MAN203: When I meet the deaf child, we communicate a bit. But because he is deaf, I use signs. If there is something he wants, he will show me using signs, then I will have long known him that he is deaf, I will understand and know what he wants. Then I will give him what he wants.
F2: So is your communication at a superficial or at a deep level?
MAN203: I think it is at a superficial level. (MAN204HS nods in agreement)
MAN201: I communicate with them at a deep level, because these children are also sent on errands like hearing children do. Maybe he is sent to me to ask for mealie-meal. He will come and tell me using signs and gestures. Then I will know that he has been sent to ask for mealie-meal. If I don't have, I will show this, using gestures, and he will know that I have nothing. Maybe he has been sent to find out if the old man of the home is around. I will reply that he is not around, and ask him who has sent him. If his father sent him, he will show this when I ask him using signs and gestures. So I communicate with them at a deep level, so that I know what he wants.
F2: Thank you. What communication responses do you get from these deaf children?
MAN202: Surely the responses are a problem for one to understand what he wants. Unless you have stayed with him for a long time, then you know that he wants this if he gives you this sign. As for that one, it's easy to understand. But if you meet for the first time, as for me I had trouble getting to understand him.
MAN204: Like she has already said, if you meet him for the first time, you have a lot of trouble understanding him. But as you get used to each other, then it becomes easier, as you will have learnt how you communicate.
MAN201: Like others have already said, it takes time to understand what they say. It is only after a long time that you will eventually understand that he wants this.
F2: What steps did you take when you discovered children's hearing problems?
MAN201: As for steps like those, you ask the parents if the child was born deaf. Maybe they will say yes he was born like that, or that he was attacked by chronic otitis media, that is what brought this condition. Then you will ask if they had sent the child to the hospital for treatment.
F2: In other words you speak to parents about the child's condition?
MAN201: Yes.
MAN203: That is the same as for me too. You ask the parents that since the child is deaf, maybe the experts might understand his condition, and might be able to help him if you took him to hospital.
F2: In other words you will be trying to establish the real cause that deafness?
ALL: Yes.
F2: What steps did you take to treat deafness in children? There is the child who is deaf; you have seen him, you have also asked the parents about it. Maybe you find the child has chronic otitis media, then what steps did you take to treat the deafness?
MAN202: You encourage the mother to send the child to the hospital so that he is further examined if the inner ear has been damaged or it is the chronic otitis media that is doing the damage. We should encourage the mother to send that child to the hospital.
F2: What about other steps besides sending the child to the hospital? It appears you are all agreeing by nodding, are there other ways?
MAN203: And sending the child to the VCWs for checking. If they find the problem is beyond their ability, then it is them who refer the child further.
MAN201: I support what the other speaker has just mentioned.
F2: Don't you sometimes send the child to traditional healers, so that they tell you the problem?
MAN202: The traditional healers, even if you send the child, will only tell you his ears have been damaged, even though at times they are not damaged beyond repair. So we don't usually believe what they say. But at the hospital the doctor examines the child. So we believe what the doctor diagnoses.
F2: Thank you very much. Is there anything that you still want to mention about treating deafness in children, maybe we have left some?
MAN203: As I had already said, the only thing to do is send the child to the hospital so that he is examined to how his hearing nerves are, that are causing this deafness.

F2: Thank you. Is there anything else you would like to say about deafness in children?
MAN201: I have a question, as I don't seem to understand these things. Some things are like this; some have a bit of some hearing, but do not speak. Others speak but are deaf. Some others, they don't hear and speak. Are these things by any way connected?
F2: Isn't we are discussing here? (Others laugh). So let us respond, the question has been thrown among us that is there any connection?
MAN202: Some are connected through hearing and speaking. In others they are not connected. In some you will find that it is deafness only but the person speaks. These are the people whose talking is opened up in some months. We have heard of such people
MAN201: Then there is a problem. I witnessed one I used to stay with at our place, who does not talk. She does not talk, right? But if you call her name and say "Maggie" you will see her turning towards you, she does not talk.
MAN202: Without giving her signs?
MAN201: Yes, without using signs. If you call her then she turns towards you, but does not speak. Others at Saba, they both don't hear and speak. So how do these nerves get so connected like this?
F2: What do you think yourself?
MAN201: I think that both the nerves that operate the oral cavity in the mouth and those that operate the ears were damaged at the same time. So that is why I want to know what really causes these conditions to be like this, maybe there is someone who can explain to me. Because if it remains this way, there is no way I can tell the parents to send the deaf child to the hospital.
F2: Sir, how do you see this?
MAN204: You know in the hospitals they examine you with their small machines that this person does not talk and does not hear. They examine. But there are some, like you have said, who are born deaf but they can speak. Then there are those born with hearing, but do not speak. There are those who cannot speak and hear. Such kind of people can be found. But what should be done is to go to the hospital to see expert doctors, who will check the whole situation.
F2: Thank you very much. But may I ask if it is possible to find some born deaf but can talk?
MAN202: I have one old woman. As for this one, she has times when she hears. It's like one month she hears a bit, the other month she completely does not hear, but she talks. She was born hearing, but became deaf as she grew up.
F2: You have explained well that this is an old woman, but a young child, is there any like that?
MAN201: No, we have never seen a child, but you may meet one sometime.
F2: What I know is that a person who is deaf, if he was born deaf, is also unable to speak. Because how can he speak when he has never heard any spoken word in his life? Those, who are deaf but do speak, will have become deaf when they were older. They will have experienced hearing people speak. So they will have been hearing, and then later became deaf. As result he will not be hearing, but because he had acquired much speaking vocabulary, he will remain speaking. That is what happens. That is why I asked one of you earlier on. Hearing comes in first, and then due to the inability to hear, he cannot learn to talk, since our talking is learnt. Is that not so?
MAN201: It is like that.
F2: When mothers say "daddy, daddy", as a baby you imitate, until the child masters to talk. At the end the child speaks intelligibly. I don't know if I have answered you?
MAN201: Yes, I have been answered.
MAN202: Like the one I am with in my class I mentioned. She was born deaf. So she does not talk, but makes sounds only.
MAN201: So not talking and not hearing go together?
MAN202: Yes, those who speak but do not hear will have acquired it later. Some are born deaf. The one I mentioned was born deaf. The mother tried to make noise on the pillow.
F2: So is there anything else you would like to say about deafness? (Pause) I take silence to mean content (participants laugh). If there is nothing else, thank you very much. Like I said, there is no right or wrong answer. We are trying to see how we can help each with these deaf children, so that their future welfare can be improved. I promise that when I write my final findings about what we have been discussing, I will come back to share with you, so that we see what we can do. Thank you for giving me your time.
ALL: We thank you too.

END

APPENDIX XV

PRELIMINARY OBSERVATIONS QUESTIONNAIRE

SCREENING AND SERVICE PROVISION FOR HEARING IMPAIRED CHILDREN AGED 3-6 IN BINGA

We would like to get your perceptions on screening and service provision for hearing impaired children in your community. Your responses would help us to get a feedback as to whether screening hearing loss in young children has any benefits in Binga. Therefore, you are kindly requested to participate in this study by filling in this questionnaire.

There is no incorrect or correct answer, so please fill in this questionnaire as honestly as possible all questions below.

Thank you.

3.0 General information:

District:..Ward you are working in:.......................................

Your institution: school ☐ hospital ☐ other gvt ☐ ngo ☐ other specify..☐......................
(Please tick)

Your profession: teacher☐ health☐ s/work☐ c/dv☐ other specify☐........................
(Please tick)

How many of your staff is specialised trained in hearing impairment? ☐

4.0 Hearing impairment

What do you associate the word hearing impairment with?

....

....

A child with a hearing loss means that s/he has a problem with ....

....

I think problems faced by a child aged 3-6 who has a hearing loss are:

a)..

b)..

c)..

d)..

I understand that the term hearing impairment means...

………

Professionals, the community and others could help a child aged 3-6 with hearing impairment in the following ways:

a)……………………………………………………………………………………………………
b)……………………………………………………………………………………………………
c)……………………………………………………………………………………………………
d)……………………………………………………………………………………………………
e)……………………………………………………………………………………………………

I think the pre- and school going age group children with hearing impairment could be helped as follows:

a)……………………………………………………………………………………………………
b)……………………………………………………………………………………………………
c)……………………………………………………………………………………………………
d)……………………………………………………………………………………………………
e)……………………………………………………………………………………………………

I think that the role of my institution towards hearing impaired children is to do the following tasks:

a)……………………………………………………………………………………………………
b)……………………………………………………………………………………………………
c)……………………………………………………………………………………………………
d)……………………………………………………………………………………………………
e)……………………………………………………………………………………………………

At the moment children with hearing impairment are rehabilitated/helped as follows in my community:

a)……………………………………………………………………………………………………
b)……………………………………………………………………………………………………
c)……………………………………………………………………………………………………
d)……………………………………………………………………………………………………
e)……………………………………………………………………………………………………

In the past 12 months I met about [ ] children with hearing impairment during my routine work.

Concerning the identification of hearing impaired children, I think it * **IS** or * **NOT** important to screen children aged 3-6 to identify hearing-impaired children (*delete the inappropriate word in bold).

Please, support your choice of the statement above ……………………………………………………

………

I, also, think that it ***IS*** **or** ***NOT** necessary to committee our meagre resources in the rehabilitation programmes of the hearing impaired children *(* delete the inappropriate word in bold).*

Please, support your choice of the statement above ....

....

3.0 Community attitudes towards people with disability

Please, place an X along the scale below; 0 means the community is very negative and 10 being very positive towards people living with disabilities for example the deaf.

Very negative	Very Positive
0.........2.........3..........4.........5.........6.........7.........8.........9.........10	

How many children aged between 3-6 were enrolled/served by your school/or institution in the year 1999?

How many children aged between 3-6 are enrolled/served by your school/or institution in the year 2000?

I estimate that about ....general and specific programmes in my catchment area community serve % of children with hearing impairment.

But my institution serves about ....% of children with hearing impairment in my catchment area community.

However, I would like to commit myself and to get involved in helping/rehabilitating children with hearing impairment during and after my routine work at my institution or within my catchment community within the coming 12 months as follows:

a)..

b)..

c)..

d)..

e)..

Sign here:.. Date:...............................

NB. *You are assured that the information given in this questionnaire will be treated strictly in confidence.*

Sd/sd

APPENDIX XVI

Letter to Parent/Guardian

REF: 98CH18

Institute of Child Health (University College London)
Centre for International Child Health
30 Guilford Street
London WC1N 1EH

20 February. 2000

Dear Parent/Guardian,

You are kindly invited to allow us to find out more about your child's hearing. We are doing this as part of a research project and hope to use the results to help us develop a hearing screen for all children in the district.

What does this study involve for me/my child?

- The hearing of some children will also be tested with a simple machine.
- If your child is thought to be deaf, he/she will be referred to Binga Hospital for further assessment.
- It is expected that deaf children will be assessed for placement at your local school.

Do I/my child have to take part?

- No. Your participation is entirely voluntary.

Yours sincerely,

Servious Dube
Research Fellow
Centre for International Child Health
Institute of Child Health

APPENDIX XVII

Letter to Follow-up Data Collection Subjects

Institute of Child Health
University College London
30 Guilford Street
London WC1N 1EH

22 January 2002

Dear Sir/ Madam

We are carrying out a study to investigate knowledge, attitudes and practice of service providers towards the inclusion of hearing-impaired children aged 3-8 years in mainstream educational activities in Binga.

The study aims to explore strategies for inclusion of deaf children in mainstream educational activities in rural Zimbabwe. It seeks to explore how the existing resources include deaf children in either pre- or primary school.

In view of this, it is very important for us to hear from someone who has experience of working in Education or Primary Health Care and get their views about including deaf children in educational activities. Please, we are therefore kindly asking you to participate in the study. Your views will be gathered through group discussions and/or questionnaires. May we say that there are no right or wrong answers regarding the subject under discussion, so your honest response is asked for. Your response is very vital for this study.

Participants are under **no** obligation to participate in this study, and may withdraw at any time without having to give reasons or due notice.

We are prepared to share with you any information relating to the study findings.

We promise to uphold a high degree of confidentiality regarding all information provided by individuals.

Thank you for sparing me your precious time.

Yours sincerely

Servious Dube
(Research Fellow)
Centre for International Child Health
Institute of Child Health

Fieldworker Number 2
Ministry of Education, Sport and Culture
Binga District Offices

APPENDIX XVIII

Refined and Recommended "Questionnaire" Screen

CAN YOUR CHILD HEAR?

(SCREENING HEARING LOSS IN CHILDREN UNDER 6)

INSTRUCTIONS TO THE INTERVIEWER ON HOW TO COMPLETE THE

QUESTIONNAIRE

This questionnaire is divided into:

a) **Part 1**; General information for each child

b) **Part 2**; Sections **'A'** to **'C'** Specific Age Group of the Child

Please fill in Part 1 and the relevant **section** from Part 2 and record your observations

RECORD YOUR SUMMARY BELOW:

SUMMARY: (COMPLETE LAST, AFTER OTHER QUESTIONS)

Observations (OB) Scale:

Please, place a cross (X) on the scale provided below your observations about the child's hearing responses to your and mother's instructions:

Always										*Never*
0	1	2	3	4	5	6	7	8	9	10

Indication of hearing loss: Yes [ ] NO [ ]

*(Please **tick** Yes or No box)*

Please Comment:

Name of the interviewer: .... Date: ....

'CAN YOUR CHILD HEAR?'- QUESTIONNAIRE

PART 1 **(For Every Child)**

GENERAL INFORMATION ABOUT THE CHILD

1. Village:……..………………………………. 2. Ward:……………………………...

3. Name of the Child: ……………….…………………..……………4. Sex: M [ ] F [ ]

5. Age: ………..(months) …………(years) ……………(year/month - local event)

6. Date of Birth:………………………………………………………………………

7. Name of School:……….………………………..………………..…………………..

(Please tick the 'yes' or the 'no' box below as honestly as possible. Thank you.)

	Yes	No	Don't know
8. Is there a family history of deafness?…………………………………………………...			
9. Was your baby born with low birth weight (<1500g)?……………………………...			
10. ………………………………………...……………………………………………			
11 …………………………………… ……………………………………………...			
12. …………………………………………………………………………………..			
13 ……………………..……………………………………..……………………..			
14. Do you have special worries about your child's ears?……………………………..			
15. Do you think your child is deaf or does not hear properly?…………………………			

Part 2

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section A

36-47 months old:

	Yes	No	Don't Know
16.			
17.			
18.			
19. Does s/he watch the speaker's face and mouth?..................			
20.			
21. Does s/he become frustrated easily when listening?..................			
22.			
23. Does the child seem particularly attentive to visual cues?..................			
24. Is the child talking?..................			
25.			

Observations by the interviewer:

(USE A SOUND LEVEL METER FOR INDICATION OF VOLUME)

Please indicate (tick) any of your observations below:

02. **Make her/him respond to mother's request (at 3 feet distance) to point at one part of her/his body in a quiet voice?**

- **i.** **Responds** [ ]
- **ii.** **No response** [ ]

02 **Make the child respond to mother's request (at 3 feet distance) to point at one part of her/his body without her/him seeing her lips?**

- **i.** **Responds** [ ]
- **ii.** **No response** [ ]

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section B

<u>48 - 59 months old</u>:

	Yes	No	Don't Know
26.			
27.			
28. Does s/he usually watch the speaker's face and mouth?..............................			
29.			
30.			
31. Do you think s/he understands better when s/he is facing you?......................			
32.			
33. Does the child seem particularly attentive to visual cues?...........................			
34. Do you understand him when you are not watching him, e.g. when you have your back to him?...			
35.			

Observations by the interviewer:

(USE A SOUND LEVEL METER FOR INDICATION OF VOLUME)

Please indicate (tick) **any of your observations below;**

01 **Make the child respond to mother's request (at 3 feet distance) to point at one part of her/his body without her/him seeing her lips (include *susu/hair and *Mpemo/nose)?**

i. **Responds** [ ]

ii. **No response** [ ]

02 **Make the child imitate speech sounds with you (Tonga words with high and low frequency)?**

i. **Speech is unclear** [ ]

ii. **Uses signs/gestures** [ ]

iii. **Normal speech/language** [ ]

<u>NB</u> ***Susu (hair) and *Mpemo (nose) are Tonga words with high and low frequency***

SPECIFIC AGE GROUP OF THE CHILD

(Select Appropriate Age Group and Complete **One** Section **Only**)

Section C

60 – 72 months old:

Question	Yes	No	Don't Know
36. ………………………………………………………………………………			
37. ………………………………………………………………………………			
38. **Does s/he usually watch the speaker's face and mouth?**…………………………..			
39. **Does s/he become frustrated easily when listening?**………………………………			
40. **Do you think s/he understands better when s/he is facing you?**…………………..			
41. ………………………………………………………………………………			
42. **Is the child's speech/language more difficult to understand than other children of her/his age group are?**………………………………………………………			
43. ………………………………………………………………………………			
44. ………………………………………………………………………………			
45. ………………………………………………………………………………			

Observations by the interviewer:

(USE A SOUND LEVEL METER FOR INDICATION OF VOLUME)

Please indicate (tick) **any of your observations below;**

01 **Make her/him respond to mother's request to point at one part of her/his body without her/him seeing her lips?**

- **i.** **Responds** [ ]
- **ii.** **No response** [ ]

02 **Make the child imitate speech sounds with you (Tonga words with high and low frequency)?**

- **i.** **Speech is unclear** [ ]
- **ii.** **Uses signs/gestures** [ ]
- **iii.** **Normal speech/language** [ ]

*NB *Susu (hair) and *Mpemo (nose) are Tonga words with high and low frequency*